SUPPORTING DESIGN REPORT FOR WETLAND DEVELOPMENT TO IMPROVE THE WATER QUALITY OF HAMILTON LAKE

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Prepared for:

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HAMILTON LAKE ENHANCEMENT PROJECT
SUPPORTING DESIGN REPORT

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INTRODUCTION

This Supporting Design Report summarizes the procedures, criteria, and results of analyses used for the design of a wetland developed to enhance the water quality of Hamilton Lake. The structure is designed to trap sediment and sediment-borne nutrients that now flow from Haughey Ditch into Hamilton Lake.

Hamilton Lake is a public recreation and scenic resource. The Haughey Ditch site is shown on Figure 1. Principal activities are boating, fishing and lakeshore recreation. The lake enhancement described in this report is being performed by the Hamilton Lake Association with partial funding from the Indiana Department of Natural Resource's T-by-2000 Program and additional support from the Natural Resources Conservation Service. Site easements have been obtained through funding by the Federal Wetland Reserve Program.

LOCATION

Hamilton Lake is a natural lake located in Otsego Township in the southern part of Steuben County, Indiana. The wetland development lies northeast of Hamilton Lake in Section 24, Township 36 N Range 14 E (Figure 2). The existing land use at the site is agricultural rowcrops. Shrubs line the streambanks in places, but this vegetation is limited to the streambanks themselves as the overbank areas are regularly tilled. Farm land surrounds the site. Normal pond area will be 7.5 acres, and the short-term detention pond will be approximately 12 acres.

DEVELOPMENT OF THE PROJECT DESIGN

Background

A 1990 feasibility study of measures to remedy water quality impairments to Hamilton Lake recommended construction of eight artificial wetlands to capture nutrient-laden sediment and reduce the influx of nutrients, particularly phosphorus, into the lake. Of the eight locations recommended in the feasibility study, two sites were eliminated during the initial phases of engineering studies. Preliminary engineering studies were conducted for the remaining six sites.

Of these, the Indiana Department of Natural Resources Division of Fish and Game questioned whether the impacts on the wildlife community would justify creation of a wetland at four of the sites. At this time, an agreement has been reached with the landowner at one of the sites (Haughey Ditch site) to proceed with development. The purpose for locating the structure at this point was to develop a wetland fed by Haughey Ditch to capture sediment and nutrients (particularly sediment-bound phosphorus) now flowing into Hamilton Lake and contributing to water quality impairments.

DESCRIPTION OF THE PROJECT

The Project consists of a low head weir that would protect Hamilton Lake water quality by retaining sediment and sediment-bound nutrients transported by small and moderate-sized storms. Nutrients retained by the structure will be available for uptake by wetland vegetation. Storms producing significant amounts of runoff would pass over the weir while generating a negligible backwater effect.

The weir crest will project 5 feet above the existing ground elevation and will extend approximately 40 feet between two small hills which form the abutments. Removal of vegetation along the footprint of the structure will be required for construction. Otherwise, disturbance of the wetland and channel during construction will be minimal.

The terrain on either side of the weir is sufficiently broad and stable to allow a backhoe to be driven up to the weir so that the structure can be maintained and accumulated sediment removed from behind the weir and the abutments.

Operation during low and normal flows

The proposed weir is designed with a notch located along the axis of Haughey Ditch. During periods of low flow, the notched-weir creates a permenant wetland behind the structure. During runoff events, a temporary detention pool is formed behind the wetland up to the elevation where water spills over the length of the weir crest. This temporary pool is designed to drain from its maximum elevation to the level of the permanent pool to allow a period of time for sediment and sediment-bound nutrients to settle in the wetland.

By allowing wetland water levels to fluctuate below the permanent pool level and the maximum flood pool, the notch aids in maintaining the hydrologic balance of the wetland. Because low flows typically carry little sediment or sediment-bound nutrients or chemicals, passage of low flows over the notch at the permanent pool level does not compromise the function of the weir as a water quality enhancement.

Operation during moderate runoff events

The primary purpose of the proposed weir is to provide a period of extended detention during moderate runoff events and during the first flush of larger events. By reducing the volume of water flowing in Haughey Ditch below the structure during these periods, runoff will be briefly retained in the wetland producing sedimentation of soil particles. Nutrients adsorbed by these particles will then be consumed by wetland vegetation rather than passing on to Hamilton Lake.

Operation during major runoff events

During high flows the weir is designed to be completely submerged and to offer little obstruction to flood flows. Because of its low height the weir will have little effect on upstream water levels and on inundation caused by flood flows. Flow of bed load sediment during floods will be impeded by the submerged weir.

Figure 3 illustrates the influence on the project on wetland hydroperiods. The wetland structure will create an area that is saturated (F) and permanently flooded (E). The structure will retard storm runoff increasing the duration of intermittent flooding (D). Drainage over the weir crest and through the notch will permit sufficiently rapid drainage to cause little expansion of the area that is semipermanently flooded (C), no expansion of the area that is seasonally flooded (B), and minor expansion of the area that is temporarily flooded (A).

- *Temporarily Flooded.* Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface.

- *Seasonally Flooded.* Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

- *Semipermanently Flooded.* Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

- *Intermittently Exposed.* Surface water is present throughout the year except in years of extreme drought.

- *Saturated.* The substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present.

HYDROLOGY AND HYDRAULICS

Flows at the site of the weir have been based on information taken from hydrological modeling carried out as part of the design study. This study is presented as Appendix A of this report. The Haughey Ditch site has a watershed area of 1.5 sq. miles and an estimated 100-year-storm flood peak of 500 cfs. Flood peaks were computed based on Indiana Department of Natural Resources guidelines using the unit hydrograph method from 100-yr, 24-hr rainfall with SCS type II rainfall distribution, infiltration losses determined from soil types and vegetation and baseflow.

ENVIRONMENTAL ISSUES

The primary environmental consequence of the project will be to reduce sediment and associated agricultural chemical transport to Hamilton Lake.

As noted in the IDNR's letter of March 10, 1992 contained in Appendix B, the Natural Heritage Program's data have been checked and, to date, no vulnerable plant or animal species of either state of federal significance have been reported to occur in the project vicinity. The letter continues by noting that Division of Fish and Wildlife staff inspected the project area on February 5, 1992 and supports Site A (Haughey Ditch site).

MAPPING AND SURVEYING

Mapping and surveying of the Hamilton Lake wetland was conducted at the Haughey Ditch project site by Williams Aerial & Mapping, Inc. during April 1990. Mapping of the vicinity of the sediment control structure is shown in Appendix C.

GEOTECHNICAL INVESTIGATIONS

To define the foundation characteristics of the proposed low weir structure, to characterize the accumulated sediment, and to establish design criteria, Harza conducted a subsurface exploration and laboratory testing program (Appendix D). The subsurface exploration program included two borings and excavation of two test pits. The laboratory testing program included the following tests: Atterberg Limits, gradation analysis, visual classification and Standard Proctor for selected samples. A pocket penetrometer and a hand torvane shear strength test kit were used in the field to evaluate the shear strength of the soil layers.

Subsurface soil exploration and laboratory testing of soil samples were conducted in accordance with standard practices. The results of the soil exploration and testing were used to determine criteria for construction of the wetland control structure.

At the site of the proposed structure, soil borings were located on either side of the proposed structure, and two test pits were excavated within the proposed wetland. The upper 8- 10 feet of soil is stiff silty clay with some sand (CL) or stiff clayey silt (ML). Below the silty clay lies gray clay (CL). The gray clay includes a two foot thick soft layer surrounding a thin (2-4 inches thick) coarse sand layer located approximately at the depth of the water table. Below the soft layer, the gray clay becomes medium to hard.

Gravelly clay was encountered at a depth of about 18 feet near the proposed right abutment location, and gravelly clayey sand was found at a depth of 4.5 feet in one of the test pits. The gravelly layers do not appear to be continuous and contain at least 40% fines. Seepage under or along gravel layers is unlikely; therefore, the sheetpile structure should provide adequate seepage cut-off.

The natural moisture content of the upper 5 feet of soil is below the plastic limit. Therefore, preliminary indications are that excavation of this material will not be a problem during construction.

It should be noted that at the time the geotechnical field work was conducted, a small embankment dam was envisioned for this site. Since this time, the design has been changed to the sheetpile structure described in this report.

The following sections present, summarize, and interpret subsurface and laboratory information that has been gathered as a result of drilling and testing of selected soil samples. Sampling and testing data are presented in Appendix D.

Field work

Field work was conducted on July 30-31 and August 6-7, 1991. The subsurface exploration program is summarized below.

The borehole locations are shown on Exhibit 2 of Appendix D. Boreholes AB1 and AB2 were located 100 to 200 feet to the east of the proposed low head weir structure. AB1 was located on the south bank approximately 30 feet from the stream channel. AB2 was located on the north bank approximately 50 feet from the stream channel.

Test pits AT1 and AT2 were located to the west of the low head weir structure. Both were located on the south side of the stream in the floodplain.

Samples were obtained at approximately one-foot intervals and were visually classified in the field. Some samples were placed into jars and retained for testing in Harza's soil laboratory.

Laboratory testing

Laboratory testing was conducted to determine the gradation of the sample, the characteristics of fine grained materials and organic content. Testing was conducted according to ASTM standards as follows:

Test	ASTM Designation
Particle-Size Analysis of Soils	D-422
Atterburg Limits	D-4318
Moisture Content	D-2216
Organic Matter Content	D-2974

Summary of field and laboratory results

At the site of the proposed structure, soil borings were located on either side of the proposed structure, and two test pits were excavated within the proposed wetland. The upper 8- 10 feet of soil is stiff silty clay with some sand (CL) or stiff clayey silt (ML). Below the silty clay lies gray clay (CL). The gray clay includes a two foot thick soft layer surrounding a thin (2-4 inches thick) coarse sand layer located approximately at the depth of the water table. Below the soft layer, the gray clay becomes medium to hard.

Gravelly clay was encountered at a depth of about 18 feet beneath the proposed right abutment, and gravelly clayey sand was found at a depth of 4.5 feet in one of the test pits. The gravelly layers do not appear to be continuous and contain at least 40% fines. Seepage under the embankment dam along gravel layers is unlikely and a seepage cut-off is not necessary.

The natural moisture content of the upper 5 feet of soil is below the plastic limit; therefore, preliminary indications are that excavation and compaction of this material will not be a problem during construction.

Conclusions

The exploration program which was conducted at the Hamilton Lake wetland site and the laboratory testing of soil samples provided information regarding soil profiles needed for design of the sediment control structure. In addition, the sampling provided information on the characteristics of the existing retained sediment.

The foundation conditions at the borehole are well defined. Dense soils were found within a few feet of the surface in all locations. The dense soil layer is sufficiently dense to provide resistance for driven piles.

PERMITTING STATUS

Permits necessary for construction of the sediment control structure have been approved. Copies of the following documents are contained in Appendix E:

- IDNR Certificate of Approval for Construction in a Floodway;
- Army Corps of Engineers Section 404 Permit; and
- Letter from the IDNR Division of Historic Preservation.

INSPECTION PLAN

Removal and off-site disposal of soft sediments

Measurement of the quantity of soft sediment removed from the site will be based on survey data. The inspector shall verify that the surveying procedure is accurate for computation of the quantity.

The inspector will verify that roadways are cleaned and maintained during construction as directed by the specifications.

Placement of sheetpile

Measurement of the quantity and type of sheetpile used will be verified by the inspector. The inspector will also verify by survey the level of the weir crest and the dimensions of the weir notch.

Restoration of shoreline to preconstruction condition

After completion of construction the inspector will verify that the shoreline and construction staging area have been restored to preconstruction condition. The inspector will be required to signify that the work is complete before the contractor will receive payment for this item.

OPERATION & MAINTENANCE/MONITORING PLAN

The weir spanning Haughey Ditch is designed to trap sediment immediately behind the low head weir. The time required to fill the sediment traps at the inlet to the wetland or to deposit sufficient sediment behind the weir to limit its effectiveness is unknown. Therefore, the determination of the long-term maintenance cycle will be based on information gathered during the first five years of site monitoring.

During the first two years, the deposition of silt in the sediment traps, the condition of the weir and its abutments, and changes in the extent or type of wetland vegetation should be inspected every six months. Sediment should be removed from behind the weir when it is more than 60 percent full. All recovered sediment should be placed in upland disposal areas outside of the delineated wetland.

After two years, if maintenance requirements prove to be minimal, then the frequency of inspection can be reduced to once every year. If maintenance requirements continue to be minimal after four years, then the maintenance schedule can be further reduced to once every two years.

Inspection and maintenance report forms are included in Appendix F.

PROJECT DESIGN

Design details of the Hamilton Lake Sediment Control Structure are presented in Appendix G, includes drawings, and a cost estimate.

Project construction costs are estimated at $79,000, including construction inspection, administration, and engineering.

FIGURES

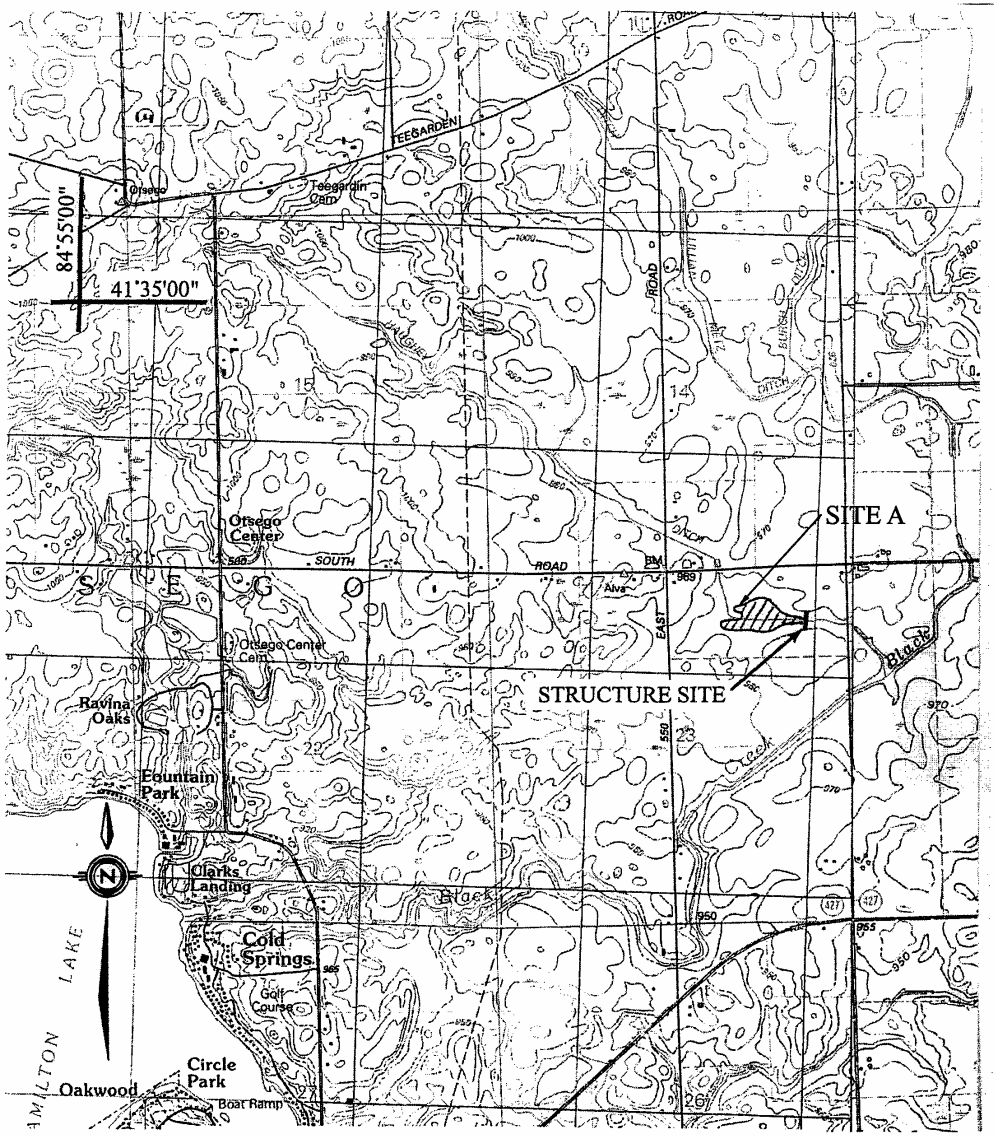

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Figure 1
SITE LOCATION MAP
SUPPORTING DESIGN REPORT
Hamilton, Indiana

z:/hamilton_lake/fig1.cdr

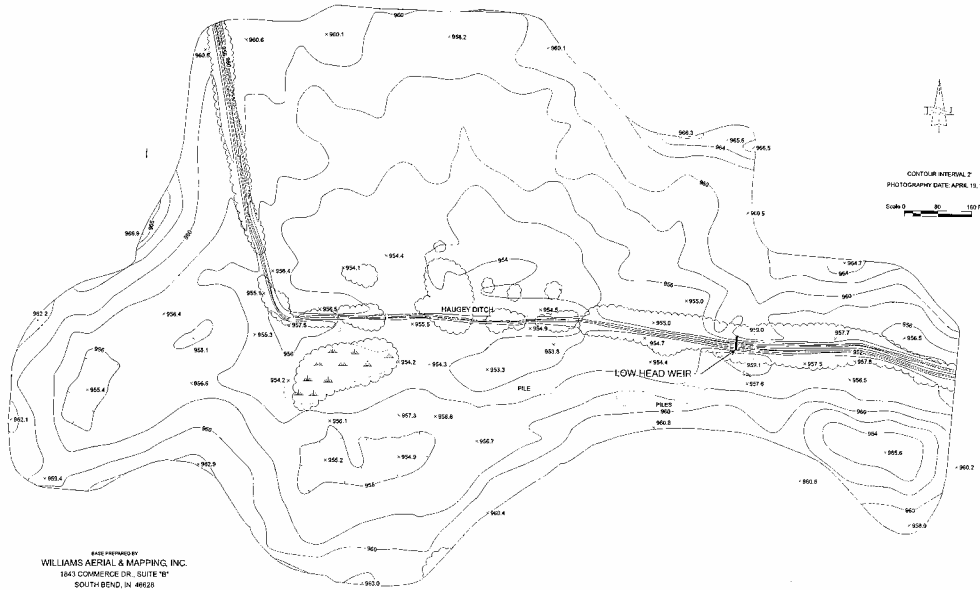

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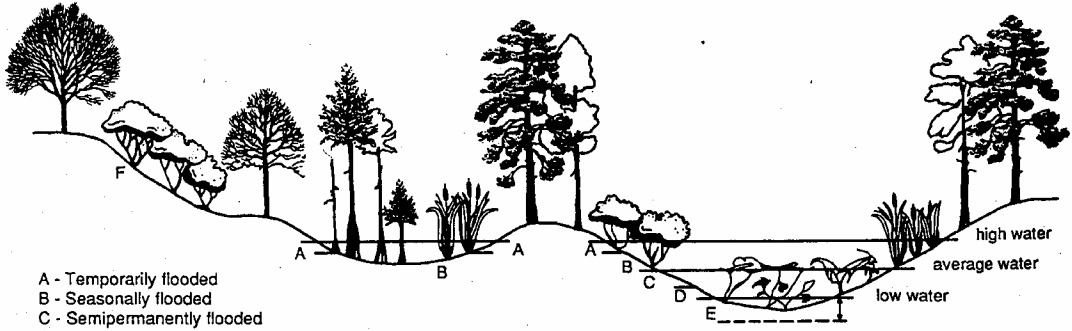
Figure 2
LOW HEAD WEIR LOCATION MAP
SUPPORTING DESIGN REPORT
Hamilton, Indiana

z:/hamilton_lake/fig3.cdr



A - Temporarily flooded
B - Seasonally flooded
C - Semipermanently flooded
D - Intermittently exposed
E - Permanently flooded
F - Saturated

(Source: Cowardin et al., 1979)

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Figure 3
WETLAND HYDROPERIOD
SUPPORTING DESIGN REPORT
Hamilton, Indiana

APPENDICES

HYDROLOGIC MODELING SUMMARY

Hydrologic analysis of the present condition and a scenario with a low head weir (modified condition) were modeled using the United States Corps of Engineers HEC-RAS hydraulic modeling computer software.

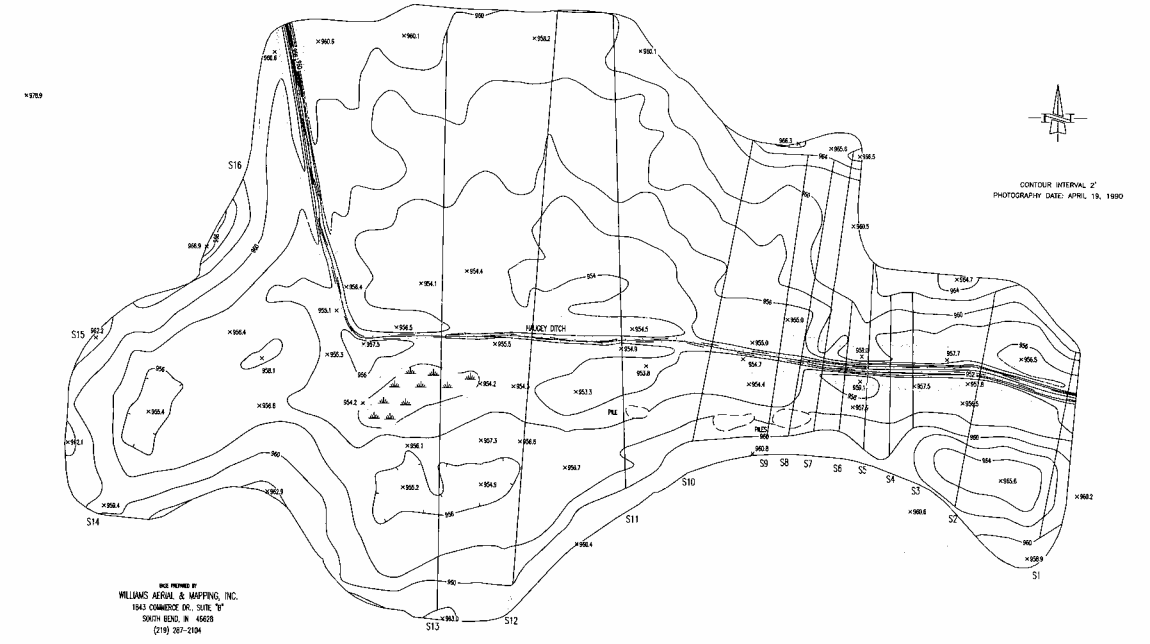
The reach of Haughey Ditch, where the proposed low head weir is recommended to be designed, was segmented into 14 profiles (Figure 1). Stream geometry, roughness coefficients, and overbank locations were added to the geometric input of the model. The flow input of the model included the addition of the estimated 100 year, 24-hour peak flow of 550 cubic feet per second, and the estimated ditch channel slope. A present condition evaluation was performed on these variables. A summary of results of the present condition model are included in Table 1 followed by a more detailed analysis in Appendix A.

The present condition model was compared to the design scenario with a low hear weir (modified condition) located in Haughey Ditch around Station 520. A summary of the modified condition results are presented in Table 1 followed by a more detailed analysis in Appendix A.

Table 1. Water Surface Elevation for Existing and Proposed Condition
550 cfs (100-year, 24-hour discharge)

Cross Section Number	Cross Section Location (feet upstream)	Water Surface Elevation existing condition (feet NGVL)	Water Surface Elevation proposed condition (feet NGVL)	Change in Water Surface Elevation (feet): Proposed - Existing
1	0	954.56	954.56	0
2	200	956.34	956.34	0
3	350	956.52	956.52	0
4	400	956.75	956.75	0
5	450	956.85	956.85	0
6	500	957.1	957.1	0
7	550	957.48	958.14	0.66
8	600	957.83	958.37	0.54
9	650	957.84	958.38	0.54
10	800	957.86	958.39	0.53
12	1000	957.87	958.4	0.53
13	1200	957.87	958.4	0.53
14	1400	957.87	958.4	0.53

Figure 1


CONTOUR INTERVAL 2'
PHOTOGRAPHY DATE: APRIL 19, 1990
MUDGEY DITCH
PILE
S16
S15
S14
S13
S12
S11
S10
S9
S8
S7
S6
S5
S4
S3
S2
S1
MAPS PREPARED BY
WILLIAMS AERIAL & MAPPING, INC.
1643 COMMERCE DR., SUITE "B"
SOUTH BEND, IN 46628
(219) 287-2104

Summary Hydraulic Analysis: Present Condition

HEC-RAS Plan: 550 CFS River: haughey Reach: haughey

Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
haughey	1400	957.87	957.87	0.00	0.00	0.00	210.88	210.18	128.94	951.19
haughey	1200	957.87	957.87	0.00	0.00	0.00	17.32	495.66	37.02	1005.28
haughey	1000	957.87	957.87	0.00	0.01	0.00	32.80	475.09	42.11	804.41
haughey	800	957.86	957.86	0.01	0.02	0.00	64.74	461.23	24.04	422.08
haughey	650	957.85	957.84	0.01	0.01	0.00	17.21	516.04	16.74	300.19
haughey	600	957.84	957.83	0.01	0.02	0.03	14.86	517.68	17.46	271.48
haughey	550	957.79	957.48	0.31	0.20	0.02	15.56	524.25	10.20	43.59
haughey	500	957.58	957.10	0.48	0.25	0.00	4.63	541.67	3.70	30.92
haughey	450	957.32	956.85	0.47	0.21	0.05	1.56	546.92	1.52	29.00
haughey	400	957.06	956.75	0.31	0.17	0.00	1.10	526.67	22.23	71.05
haughey	350	956.88	956.52	0.36	0.20	0.01	19.76	507.76	22.48	72.83
haughey	200	956.68	956.34	0.34	1.16	0.06	2.58	544.50	2.92	68.15
haughey	0	955.46	954.56	0.90			8.30	531.28	10.42	49.70

HEC-RAS Plan: 550 CFS River: haughey Reach: haughey

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
haughey	1400	550.00	954.00	957.87		957.87	0.000022	0.32	1760.90	951.19	0.03
haughey	1200	550.00	953.50	957.87		957.87	0.000011	0.24	2429.98	1005.28	0.02
haughey	1000	550.00	953.00	957.87		957.87	0.000012	0.27	2128.26	804.41	0.03
haughey	800	550.00	952.60	957.86		957.86	0.000100	0.69	853.77	422.08	0.07
haughey	650	550.00	952.20	957.84		957.85	0.000124	0.76	746.13	300.19	0.08
haughey	600	550.00	952.05	957.83		957.84	0.000145	0.83	683.60	271.48	0.08
haughey	550	550.00	951.90	957.48		957.79	0.003078	4.52	127.50	43.59	0.39
haughey	500	550.00	951.80	957.10		957.58	0.005120	5.59	100.50	30.92	0.49
haughey	450	550.00	951.70	956.85		957.32	0.005050	5.52	100.66	29.00	0.49
haughey	400	550.00	951.60	956.75		957.06	0.003513	4.58	130.26	71.05	0.41
haughey	350	550.00	951.50	956.52		956.88	0.003473	5.01	125.17	72.83	0.43
haughey	200	550.00	951.30	956.34		956.68	0.004629	4.69	121.39	68.15	0.46
haughey	0	550.00	950.70	954.56	954.56	955.46	0.015408	7.71	75.98	49.70	0.81

Summary Hydraulic Analysis: Modified Condition

HEC-RAS Plan: final plan River: haughey Reach: haughey

Reach	River Sta	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
		(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
haughey	1400	958.40	958.40	0.00	0.00	0.00	224.34	187.95	137.71	1019.10
haughey	1200	958.40	958.40	0.00	0.00	0.00	24.54	469.67	55.80	1079.76
haughey	1000	958.40	958.40	0.00	0.00	0.00	50.71	450.95	48.34	841.97
haughey	800	958.39	958.39	0.00	0.01	0.00	93.00	423.55	33.45	458.83
haughey	650	958.38	958.38	0.01	0.00	0.00	21.17	503.78	25.05	352.35
haughey	600	958.38	958.37	0.01	0.01	0.02	21.42	502.83	25.75	292.45
haughey	550	958.35	958.14	0.21			23.90	509.09	17.02	240.71
haughey	520	Inline Weir								
haughey	500	957.58	957.10	0.48	0.25	0.00	4.63	541.67	3.70	30.92
haughey	450	957.32	956.85	0.47	0.21	0.05	1.56	546.92	1.52	29.00
haughey	400	957.06	956.75	0.31	0.17	0.00	1.10	526.67	22.23	71.05
haughey	350	956.88	956.52	0.36	0.20	0.01	19.76	507.76	22.48	72.83
haughey	200	956.68	956.34	0.34	1.16	0.06	2.58	544.50	2.92	68.15
haughey	0	955.46	954.56	0.90			8.30	531.28	10.42	49.70

HEC-RAS Plan: final plan River: haughey Reach: haughey

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
		(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
haughey	1400	550.00	954.00	958.40	955.40	958.40	0.000010	0.24	2279.21	1019.10	0.02
haughey	1200	550.00	953.50	958.40		958.40	0.000006	0.20	2981.30	1079.76	0.02
haughey	1000	550.00	953.00	958.40		958.40	0.000007	0.22	2564.81	841.97	0.02
haughey	800	550.00	952.60	958.39		958.39	0.000049	0.54	1090.07	458.83	0.05
haughey	650	550.00	952.20	958.38		958.38	0.000067	0.63	920.14	352.35	0.06
haughey	600	550.00	952.05	958.37		958.38	0.000079	0.68	837.02	292.45	0.06
haughey	550	550.00	951.90	958.14	955.53	958.35	0.001775	3.79	185.23	240.71	0.30
haughey	520	Inline Weir									
haughey	500	550.00	951.80	957.10		957.58	0.005120	5.59	100.50	30.92	0.49
haughey	450	550.00	951.70	956.85		957.32	0.005050	5.52	100.66	29.00	0.49
haughey	400	550.00	951.60	956.75		957.06	0.003513	4.58	130.26	71.05	0.41
haughey	350	550.00	951.50	956.52		956.88	0.003473	5.01	125.17	72.83	0.43
haughey	200	550.00	951.30	956.34		956.68	0.004629	4.69	121.39	68.15	0.46
haughey	0	550.00	950.70	954.56	954.56	955.46	0.015408	7.71	75.98	49.70	0.81

Profile Detailed Hydraulic Analysis: Present Condition

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 1400 Profile: PF 1

E.G. Elev (ft)	957.87	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.87	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)	955.40	Flow Area (sq ft)	686.48	665.83	408.59
E.G. Slope (ft/ft)	0.000022	Area (sq ft)	686.48	665.83	408.59
Q Total (cfs)	550.00	Flow (cfs)	210.88	210.18	128.94
Top Width (ft)	951.19	Top Width (ft)	457.72	231.82	261.65
Vel Total (ft/s)	0.31	Avg. Vel. (ft/s)	0.31	0.32	0.32
Max Chl Dpth (ft)	3.87	Hydr. Depth (ft)	1.50	2.87	1.56
Conv. Total (cfs)	116187.9	Conv. (cfs)	44549.6	44399.9	27238.3
Length Wtd. (ft)	200.00	Wetted Per. (ft)	457.73	232.01	261.67
Min Ch El (ft)	954.00	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.00	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	3.70	25.07	3.21
C & E Loss (ft)	0.00	Cum SA (acres)	3.39	7.57	2.75

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 1200 Profile: PF 1

E.G. Elev (ft)	957.87	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.87	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)		Flow Area (sq ft)	112.35	2077.48	240.15
E.G. Slope (ft/ft)	0.000011	Area (sq ft)	112.35	2077.48	240.15
Q Total (cfs)	550.00	Flow (cfs)	17.32	495.66	37.02
Top Width (ft)	1005.28	Top Width (ft)	120.18	628.21	256.89
Vel Total (ft/s)	0.23	Avg. Vel. (ft/s)	0.15	0.24	0.15
Max Chl Dpth (ft)	4.37	Hydr. Depth (ft)	0.93	3.31	0.93
Conv. Total (cfs)	168949.7	Conv. (cfs)	5320.1	152257.6	11372.1
Length Wtd. (ft)	200.00	Wetted Per. (ft)	120.20	628.27	256.89
Min Ch El (ft)	953.50	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.05	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	1.86	18.78	1.72
C & E Loss (ft)	0.00	Cum SA (acres)	2.06	5.60	1.56

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 1000 Profile: PF 1

E.G. Elev (ft)	957.87	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.87	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)		Flow Area (sq ft)	198.93	1755.26	174.07
E.G. Slope (ft/ft)	0.000012	Area (sq ft)	198.93	1755.26	174.07
Q Total (cfs)	550.00	Flow (cfs)	32.80	475.09	42.11
Top Width (ft)	804.41	Top Width (ft)	213.09	486.47	104.86
Vel Total (ft/s)	0.26	Avg. Vel. (ft/s)	0.16	0.27	0.24
Max Chl Dpth (ft)	4.87	Hydr. Depth (ft)	0.93	3.61	1.66

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 1000 Profile: PF 1 (Continued)

Conv. Total (cfs)	157805.8	Conv. (cfs)	9411.5	136312.4	12082.0
Length Wtd. (ft)	200.00	Wetted Per. (ft)	213.09	486.66	104.93
Min Ch El (ft)	953.00	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.04	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	1.15	9.98	0.77
C & E Loss (ft)	0.00	Cum SA (acres)	1.30	3.04	0.73

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 800 Profile: PF 1

E.G. Elev (ft)	957.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.86	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	137.19	665.62	50.95
E.G. Slope (ft/ft)	0.000100	Area (sq ft)	137.19	665.62	50.95
Q Total (cfs)	550.00	Flow (cfs)	64.74	461.23	24.04
Top Width (ft)	422.08	Top Width (ft)	147.88	219.28	54.92
Vel Total (ft/s)	0.64	Avg. Vel. (ft/s)	0.47	0.69	0.47
Max Chl Dpth (ft)	5.26	Hydr. Depth (ft)	0.93	3.04	0.93
Conv. Total (cfs)	54912.2	Conv. (cfs)	6463.5	46048.9	2399.7
Length Wtd. (ft)	150.00	Wetted Per. (ft)	147.89	219.49	54.95
Min Ch El (ft)	952.60	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.06	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.38	4.42	0.25
C & E Loss (ft)	0.00	Cum SA (acres)	0.47	1.42	0.36

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 650 Profile: PF 1

E.G. Elev (ft)	957.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.84	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	33.11	680.80	32.21
E.G. Slope (ft/ft)	0.000124	Area (sq ft)	33.11	680.80	32.21
Q Total (cfs)	550.00	Flow (cfs)	17.21	516.04	16.74
Top Width (ft)	300.19	Top Width (ft)	36.06	229.06	35.07
Vel Total (ft/s)	0.74	Avg. Vel. (ft/s)	0.52	0.76	0.52
Max Chl Dpth (ft)	5.64	Hydr. Depth (ft)	0.92	2.97	0.92
Conv. Total (cfs)	49467.4	Conv. (cfs)	1548.3	46413.0	1506.1
Length Wtd. (ft)	50.00	Wetted Per. (ft)	36.10	229.49	35.12
Min Ch El (ft)	952.20	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.02	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.09	2.10	0.11
C & E Loss (ft)	0.00	Cum SA (acres)	0.15	0.65	0.21

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 350 Profile: PF 1

E.G. Elev (ft)	956.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.52	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	11.13	101.41	12.63
E.G. Slope (ft/ft)	0.003473	Area (sq ft)	11.13	101.41	12.63
Q Total (cfs)	550.00	Flow (cfs)	19.76	507.76	22.48
Top Width (ft)	72.83	Top Width (ft)	23.01	23.72	26.09
Vel Total (ft/s)	4.39	Avg. Vel. (ft/s)	1.77	5.01	1.78
Max Chl Dpth (ft)	5.02	Hydr. Depth (ft)	0.48	4.28	0.48
Conv. Total (cfs)	9332.2	Conv. (cfs)	335.2	8615.5	381.5
Length Wtd. (ft)	50.00	Wetted Per. (ft)	23.48	24.57	26.51
Min Ch El (ft)	951.50	Shear (lb/sq ft)	0.10	0.89	0.10
Alpha	1.21	Stream Power (lb/ft s)	0.18	4.48	0.18
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	0.02	0.44	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.07	0.14	0.08

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 200 Profile: PF 1

E.G. Elev (ft)	956.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.34	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	2.51	116.05	2.83
E.G. Slope (ft/ft)	0.004629	Area (sq ft)	2.51	116.05	2.83
Q Total (cfs)	550.00	Flow (cfs)	2.58	544.50	2.92
Top Width (ft)	68.15	Top Width (ft)	14.84	36.52	16.79
Vel Total (ft/s)	4.53	Avg. Vel. (ft/s)	1.03	4.69	1.03
Max Chl Dpth (ft)	5.04	Hydr. Depth (ft)	0.17	3.18	0.17
Conv. Total (cfs)	8084.0	Conv. (cfs)	37.9	8003.2	42.9
Length Wtd. (ft)	150.00	Wetted Per. (ft)	14.85	38.45	16.79
Min Ch El (ft)	951.30	Shear (lb/sq ft)	0.05	0.87	0.05
Alpha	1.06	Stream Power (lb/ft s)	0.05	4.09	0.05
Frctn Loss (ft)	1.16	Cum Volume (acre-ft)	0.01	0.32	0.01
C & E Loss (ft)	0.06	Cum SA (acres)	0.04	0.11	0.05

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 0 Profile: PF 1

E.G. Elev (ft)	955.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.90	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	954.56	Reach Len. (ft)			
Crit W.S. (ft)	954.56	Flow Area (sq ft)	3.14	68.90	3.94
E.G. Slope (ft/ft)	0.015408	Area (sq ft)	3.14	68.90	3.94
Q Total (cfs)	550.00	Flow (cfs)	8.30	531.28	10.42
Top Width (ft)	49.70	Top Width (ft)	11.12	24.62	13.96
Vel Total (ft/s)	7.24	Avg. Vel. (ft/s)	2.64	7.71	2.64
Max Chl Dpth (ft)	3.86	Hydr. Depth (ft)	0.28	2.80	0.28

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 500 Profile: PF 1 (Continued)

Conv. Total (cfs)	7686.1	Conv. (cfs)	64.7	7569.7	51.7
Length Wtd. (ft)	50.00	Wetted Per. (ft)	3.82	26.61	3.16
Min Ch El (ft)	951.80	Shear (lb/sq ft)	0.17	1.16	0.16
Alpha	1.03	Stream Power (lb/ft s)	0.39	6.51	0.37
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)	0.03	0.80	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.09	0.23	0.14

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 450 Profile: PF 1

E.G. Elev (ft)	957.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.85	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	0.83	99.01	0.81
E.G. Slope (ft/ft)	0.005050	Area (sq ft)	0.83	99.01	0.81
Q Total (cfs)	550.00	Flow (cfs)	1.56	546.92	1.52
Top Width (ft)	29.00	Top Width (ft)	1.96	25.13	1.91
Vel Total (ft/s)	5.46	Avg. Vel. (ft/s)	1.88	5.52	1.87
Max Chl Dpth (ft)	5.15	Hydr. Depth (ft)	0.42	3.94	0.42
Conv. Total (cfs)	7739.6	Conv. (cfs)	22.0	7696.3	21.3
Length Wtd. (ft)	50.00	Wetted Per. (ft)	2.14	27.41	2.09
Min Ch El (ft)	951.70	Shear (lb/sq ft)	0.12	1.14	0.12
Alpha	1.02	Stream Power (lb/ft s)	0.23	6.29	0.23
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	0.03	0.69	0.04
C & E Loss (ft)	0.05	Cum SA (acres)	0.08	0.20	0.14

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 400 Profile: PF 1

E.G. Elev (ft)	957.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.75	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	0.75	114.94	14.56
E.G. Slope (ft/ft)	0.003513	Area (sq ft)	0.75	114.94	14.56
Q Total (cfs)	550.00	Flow (cfs)	1.10	526.67	22.23
Top Width (ft)	71.05	Top Width (ft)	2.01	30.18	38.85
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)	1.46	4.58	1.53
Max Chl Dpth (ft)	5.15	Hydr. Depth (ft)	0.37	3.81	0.37
Conv. Total (cfs)	9279.9	Conv. (cfs)	18.6	8886.3	375.0
Length Wtd. (ft)	50.00	Wetted Per. (ft)	2.15	32.08	38.86
Min Ch El (ft)	951.60	Shear (lb/sq ft)	0.08	0.79	0.08
Alpha	1.13	Stream Power (lb/ft s)	0.11	3.60	0.13
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)	0.02	0.57	0.04
C & E Loss (ft)	0.00	Cum SA (acres)	0.08	0.17	0.11

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 350 Profile: PF 1

E.G. Elev (ft)	956.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.52	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	11.13	101.41	12.63
E.G. Slope (ft/ft)	0.003473	Area (sq ft)	11.13	101.41	12.63
Q Total (cfs)	550.00	Flow (cfs)	19.76	507.76	22.48
Top Width (ft)	72.83	Top Width (ft)	23.01	23.72	26.09
Vel Total (ft/s)	4.39	Avg. Vel. (ft/s)	1.77	5.01	1.78
Max Chl Dpth (ft)	5.02	Hydr. Depth (ft)	0.48	4.28	0.48
Conv. Total (cfs)	9332.2	Conv. (cfs)	335.2	8615.5	381.5
Length Wtd. (ft)	50.00	Wetted Per. (ft)	23.48	24.57	26.51
Min Ch El (ft)	951.50	Shear (lb/sq ft)	0.10	0.89	0.10
Alpha	1.21	Stream Power (lb/ft s)	0.18	4.48	0.18
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	0.02	0.44	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.07	0.14	0.08

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 200 Profile: PF 1

E.G. Elev (ft)	956.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.34	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	2.51	116.05	2.83
E.G. Slope (ft/ft)	0.004629	Area (sq ft)	2.51	116.05	2.83
Q Total (cfs)	550.00	Flow (cfs)	2.58	544.50	2.92
Top Width (ft)	68.15	Top Width (ft)	14.84	36.52	16.79
Vel Total (ft/s)	4.53	Avg. Vel. (ft/s)	1.03	4.69	1.03
Max Chl Dpth (ft)	5.04	Hydr. Depth (ft)	0.17	3.18	0.17
Conv. Total (cfs)	8084.0	Conv. (cfs)	37.9	8003.2	42.9
Length Wtd. (ft)	150.00	Wetted Per. (ft)	14.85	38.45	16.79
Min Ch El (ft)	951.30	Shear (lb/sq ft)	0.05	0.87	0.05
Alpha	1.06	Stream Power (lb/ft s)	0.05	4.09	0.05
Frctn Loss (ft)	1.16	Cum Volume (acre-ft)	0.01	0.32	0.01
C & E Loss (ft)	0.06	Cum SA (acres)	0.04	0.11	0.05

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 0 Profile: PF 1

E.G. Elev (ft)	955.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.90	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	954.56	Reach Len. (ft)			
Crit W.S. (ft)	954.56	Flow Area (sq ft)	3.14	68.90	3.94
E.G. Slope (ft/ft)	0.015408	Area (sq ft)	3.14	68.90	3.94
Q Total (cfs)	550.00	Flow (cfs)	8.30	531.28	10.42
Top Width (ft)	49.70	Top Width (ft)	11.12	24.62	13.96
Vel Total (ft/s)	7.24	Avg. Vel. (ft/s)	2.64	7.71	2.64
Max Chl Dpth (ft)	3.86	Hydr. Depth (ft)	0.28	2.80	0.28

Plan: 550 CFS River: haughey Reach:haughey Riv Sta: 0 Profile: PF 1 (Continued)

Conv. Total (cfs)	4430.8	Conv. (cfs)	66.9	4280.0	84.0
Length Wtd. (ft)		Wetted Per. (ft)	11.14	26.70	13.97
Min Ch El (ft)	950.70	Shear (lb/sq ft)	0.27	2.48	0.27
Alpha	1.10	Stream Power (lb/ft s)	0.72	19.14	0.72
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Profile Detailed Hydraulic Analysis: Modified Condition

Plan: final plan River: haughey Reach:haughey Riv Sta: 1400 Profile: PF 1

E.G. Elev (ft)	958.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.40	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)	955.40	Flow Area (sq ft)	940.59	787.68	550.93
E.G. Slope (ft/ft)	0.000010	Area (sq ft)	940.59	787.68	550.93
Q Total (cfs)	550.00	Flow (cfs)	224.34	187.95	137.71
Top Width (ft)	1019.10	Top Width (ft)	509.27	231.82	278.01
Vel Total (ft/s)	0.24	Avg. Vel. (ft/s)	0.24	0.24	0.25
Max Chl Dpth (ft)	4.40	Hydr. Depth (ft)	1.85	3.40	1.98
Conv. Total (cfs)	171932.5	Conv. (cfs)	70129.8	58752.8	43049.8
Length Wtd. (ft)	200.00	Wetted Per. (ft)	509.28	232.01	278.04
Min Ch El (ft)	954.00	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.00	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	5.64	28.96	4.70
C & E Loss (ft)	0.00	Cum SA (acres)	4.14	7.57	3.19

Plan: final plan River: haughey Reach:haughey Riv Sta: 1200 Profile: PF 1

E.G. Elev (ft)	958.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.40	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)		Flow Area (sq ft)	185.67	2408.45	387.18
E.G. Slope (ft/ft)	0.000006	Area (sq ft)	185.67	2408.45	387.18
Q Total (cfs)	550.00	Flow (cfs)	24.54	469.67	55.80
Top Width (ft)	1079.76	Top Width (ft)	159.50	628.21	292.06
Vel Total (ft/s)	0.18	Avg. Vel. (ft/s)	0.13	0.20	0.14
Max Chl Dpth (ft)	4.90	Hydr. Depth (ft)	1.16	3.83	1.33
Conv. Total (cfs)	228115.6	Conv. (cfs)	10176.3	194797.0	23142.3
Length Wtd. (ft)	200.00	Wetted Per. (ft)	159.51	628.27	292.07
Min Ch El (ft)	953.50	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.04	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	3.05	21.62	2.55
C & E Loss (ft)	0.00	Cum SA (acres)	2.61	5.60	1.88

Plan: final plan River: haughey Reach:haughey Riv Sta: 1000 Profile: PF 1

E.G. Elev (ft)	958.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.40	Reach Len. (ft)	200.00	200.00	200.00
Crit W.S. (ft)		Flow Area (sq ft)	320.92	2012.09	231.80
E.G. Slope (ft/ft)	0.000007	Area (sq ft)	320.92	2012.09	231.80
Q Total (cfs)	550.00	Flow (cfs)	50.71	450.95	48.34
Top Width (ft)	841.97	Top Width (ft)	240.85	486.47	114.65
Vel Total (ft/s)	0.21	Avg. Vel. (ft/s)	0.16	0.22	0.21
Max Chl Dpth (ft)	5.40	Hydr. Depth (ft)	1.33	4.14	2.02

Plan: final plan River: haughey Reach:haughey Riv Sta: 1000 Profile: PF 1 (Continued)

Conv. Total (cfs)	208744.8	Conv. (cfs)	19246.2	171151.3	18347.3
Length Wtd. (ft)	200.00	Wetted Per. (ft)	240.86	486.66	114.74
Min Ch El (ft)	953.00	Shear (lb/sq ft)	0.00	0.00	0.00
Alpha	1.03	Stream Power (lb/ft s)	0.00	0.00	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	1.89	11.47	1.13
C & E Loss (ft)	0.00	Cum SA (acres)	1.69	3.04	0.94

Plan: final plan River: haughey Reach:haughey Riv Sta: 800 Profile: PF 1

E.G. Elev (ft)	958.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.39	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	223.56	782.49	84.02
E.G. Slope (ft/ft)	0.000049	Area (sq ft)	223.56	782.49	84.02
Q Total (cfs)	550.00	Flow (cfs)	93.00	423.55	33.45
Top Width (ft)	458.83	Top Width (ft)	170.95	219.28	68.60
Vel Total (ft/s)	0.50	Avg. Vel. (ft/s)	0.42	0.54	0.40
Max Chl Dpth (ft)	5.79	Hydr. Depth (ft)	1.31	3.57	1.22
Conv. Total (cfs)	78301.0	Conv. (cfs)	13240.7	60298.2	4762.1
Length Wtd. (ft)	150.00	Wetted Per. (ft)	170.97	219.49	68.64
Min Ch El (ft)	952.60	Shear (lb/sq ft)	0.00	0.01	0.00
Alpha	1.04	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.64	5.06	0.40
C & E Loss (ft)	0.00	Cum SA (acres)	0.74	1.42	0.52

Plan: final plan River: haughey Reach:haughey Riv Sta: 650 Profile: PF 1

E.G. Elev (ft)	958.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.38	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	61.75	804.76	53.64
E.G. Slope (ft/ft)	0.000067	Area (sq ft)	61.75	804.76	53.64
Q Total (cfs)	550.00	Flow (cfs)	21.17	503.78	25.05
Top Width (ft)	352.35	Top Width (ft)	79.74	229.06	43.55
Vel Total (ft/s)	0.60	Avg. Vel. (ft/s)	0.34	0.63	0.47
Max Chl Dpth (ft)	6.18	Hydr. Depth (ft)	0.77	3.51	1.23
Conv. Total (cfs)	66962.6	Conv. (cfs)	2577.8	61335.4	3049.3
Length Wtd. (ft)	50.00	Wetted Per. (ft)	79.79	229.49	43.62
Min Ch El (ft)	952.20	Shear (lb/sq ft)	0.00	0.01	0.01
Alpha	1.05	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.15	2.32	0.16
C & E Loss (ft)	0.00	Cum SA (acres)	0.31	0.65	0.33

Plan: final plan River: haughey Reach:haughey Riv Sta: 600 Profile: PF 1

E.G. Elev (ft)	958.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.37	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	45.00	739.64	52.38
E.G. Slope (ft/ft)	0.000079	Area (sq ft)	45.00	739.64	52.38
Q Total (cfs)	550.00	Flow (cfs)	21.42	502.83	25.75
Top Width (ft)	292.45	Top Width (ft)	39.79	208.52	44.15
Vel Total (ft/s)	0.66	Avg. Vel. (ft/s)	0.48	0.68	0.49
Max Chl Dpth (ft)	6.32	Hydr. Depth (ft)	1.13	3.55	1.19
Conv. Total (cfs)	62044.6	Conv. (cfs)	2416.7	56722.9	2905.1
Length Wtd. (ft)	50.00	Wetted Per. (ft)	39.86	208.97	44.21
Min Ch El (ft)	952.05	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.03	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.09	1.44	0.10
C & E Loss (ft)	0.02	Cum SA (acres)	0.24	0.40	0.28

Plan: final plan River: haughey Reach:haughey Riv Sta: 550 Profile: PF 1

E.G. Elev (ft)	958.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	958.14	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)	955.53	Flow Area (sq ft)	28.88	134.35	22.00
E.G. Slope (ft/ft)	0.001775	Area (sq ft)	28.88	134.35	22.00
Q Total (cfs)	550.00	Flow (cfs)	23.90	509.09	17.02
Top Width (ft)	240.71	Top Width (ft)	115.46	27.97	97.28
Vel Total (ft/s)	2.97	Avg. Vel. (ft/s)	0.83	3.79	0.77
Max Chl Dpth (ft)	6.24	Hydr. Depth (ft)	0.25	4.80	0.23
Conv. Total (cfs)	13055.0	Conv. (cfs)	567.3	12083.9	403.9
Length Wtd. (ft)	50.00	Wetted Per. (ft)	115.62	29.89	97.52
Min Ch El (ft)	951.90	Shear (lb/sq ft)	0.03	0.50	0.02
Alpha	1.51	Stream Power (lb/ft s)	0.02	1.89	0.02
Frctn Loss (ft)		Cum Volume (acre-ft)	0.04	0.94	0.06
C & E Loss (ft)		Cum SA (acres)	0.15	0.26	0.20

Plan: final plan River: haughey Reach:haughey Riv Sta: 500 Profile: PF 1

E.G. Elev (ft)	957.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	957.10	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	2.01	96.87	1.62
E.G. Slope (ft/ft)	0.005120	Area (sq ft)	2.01	96.87	1.62
Q Total (cfs)	550.00	Flow (cfs)	4.63	541.67	3.70
Top Width (ft)	30.92	Top Width (ft)	3.66	24.30	2.96
Vel Total (ft/s)	5.47	Avg. Vel. (ft/s)	2.31	5.59	2.28
Max Chl Dpth (ft)	5.30	Hydr. Depth (ft)	0.55	3.99	0.55

Plan: final plan River: haughey Reach:haughey Riv Sta: 500 Profile: PF 1 (Continued)

Conv. Total (cfs)	7686.1	Conv. (cfs)	64.7	7569.7	51.7
Length Wtd. (ft)	50.00	Wetted Per. (ft)	3.82	26.61	3.16
Min Ch El (ft)	951.80	Shear (lb/sq ft)	0.17	1.16	0.16
Alpha	1.03	Stream Power (lb/ft s)	0.39	6.51	0.37
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)	0.03	0.80	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.09	0.23	0.14

Plan: final plan River: haughey Reach:haughey Riv Sta: 450 Profile: PF 1

E.G. Elev (ft)	957.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.85	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	0.83	99.01	0.81
E.G. Slope (ft/ft)	0.005050	Area (sq ft)	0.83	99.01	0.81
Q Total (cfs)	550.00	Flow (cfs)	1.56	546.92	1.52
Top Width (ft)	29.00	Top Width (ft)	1.96	25.13	1.91
Vel Total (ft/s)	5.46	Avg. Vel. (ft/s)	1.88	5.52	1.87
Max Chl Dpth (ft)	5.15	Hydr. Depth (ft)	0.42	3.94	0.42
Conv. Total (cfs)	7739.6	Conv. (cfs)	22.0	7696.3	21.3
Length Wtd. (ft)	50.00	Wetted Per. (ft)	2.14	27.41	2.09
Min Ch El (ft)	951.70	Shear (lb/sq ft)	0.12	1.14	0.12
Alpha	1.02	Stream Power (lb/ft s)	0.23	6.29	0.23
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	0.03	0.69	0.04
C & E Loss (ft)	0.05	Cum SA (acres)	0.08	0.20	0.14

Plan: final plan River: haughey Reach:haughey Riv Sta: 400 Profile: PF 1

E.G. Elev (ft)	957.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.75	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	0.75	114.94	14.56
E.G. Slope (ft/ft)	0.003513	Area (sq ft)	0.75	114.94	14.56
Q Total (cfs)	550.00	Flow (cfs)	1.10	526.67	22.23
Top Width (ft)	71.05	Top Width (ft)	2.01	30.18	38.85
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)	1.46	4.58	1.53
Max Chl Dpth (ft)	5.15	Hydr. Depth (ft)	0.37	3.81	0.37
Conv. Total (cfs)	9279.9	Conv. (cfs)	18.6	8886.3	375.0
Length Wtd. (ft)	50.00	Wetted Per. (ft)	2.15	32.08	38.86
Min Ch El (ft)	951.60	Shear (lb/sq ft)	0.08	0.79	0.08
Alpha	1.13	Stream Power (lb/ft s)	0.11	3.60	0.13
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)	0.02	0.57	0.04
C & E Loss (ft)	0.00	Cum SA (acres)	0.08	0.17	0.11

Plan: final plan River: haughey Reach:haughey Riv Sta: 350 Profile: PF 1

E.G. Elev (ft)	956.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.52	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)	11.13	101.41	12.63
E.G. Slope (ft/ft)	0.003473	Area (sq ft)	11.13	101.41	12.63
Q Total (cfs)	550.00	Flow (cfs)	19.76	507.76	22.48
Top Width (ft)	72.83	Top Width (ft)	23.01	23.72	26.09
Vel Total (ft/s)	4.39	Avg. Vel. (ft/s)	1.77	5.01	1.78
Max Chl Dpth (ft)	5.02	Hydr. Depth (ft)	0.48	4.28	0.48
Conv. Total (cfs)	9332.2	Conv. (cfs)	335.2	8615.5	381.5
Length Wtd. (ft)	50.00	Wetted Per. (ft)	23.48	24.57	26.51
Min Ch El (ft)	951.50	Shear (lb/sq ft)	0.10	0.89	0.10
Alpha	1.21	Stream Power (lb/ft s)	0.18	4.48	0.18
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	0.02	0.44	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.07	0.14	0.08

Plan: final plan River: haughey Reach:haughey Riv Sta: 200 Profile: PF 1

E.G. Elev (ft)	956.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	956.34	Reach Len. (ft)	150.00	150.00	150.00
Crit W.S. (ft)		Flow Area (sq ft)	2.51	116.05	2.83
E.G. Slope (ft/ft)	0.004629	Area (sq ft)	2.51	116.05	2.83
Q Total (cfs)	550.00	Flow (cfs)	2.58	544.50	2.92
Top Width (ft)	68.15	Top Width (ft)	14.84	36.52	16.79
Vel Total (ft/s)	4.53	Avg. Vel. (ft/s)	1.03	4.69	1.03
Max Chl Dpth (ft)	5.04	Hydr. Depth (ft)	0.17	3.18	0.17
Conv. Total (cfs)	8084.0	Conv. (cfs)	37.9	8003.2	42.9
Length Wtd. (ft)	150.00	Wetted Per. (ft)	14.85	38.45	16.79
Min Ch El (ft)	951.30	Shear (lb/sq ft)	0.05	0.87	0.05
Alpha	1.06	Stream Power (lb/ft s)	0.05	4.09	0.05
Frctn Loss (ft)	1.16	Cum Volume (acre-ft)	0.01	0.32	0.01
C & E Loss (ft)	0.06	Cum SA (acres)	0.04	0.11	0.05

Plan: final plan River: haughey Reach:haughey Riv Sta: 0 Profile: PF 1

E.G. Elev (ft)	955.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.90	Wt. n-Val.	0.030	0.045	0.030
W.S. Elev (ft)	954.56	Reach Len. (ft)			
Crit W.S. (ft)	954.56	Flow Area (sq ft)	3.14	68.90	3.94
E.G. Slope (ft/ft)	0.015408	Area (sq ft)	3.14	68.90	3.94
Q Total (cfs)	550.00	Flow (cfs)	8.30	531.28	10.42
Top Width (ft)	49.70	Top Width (ft)	11.12	24.62	13.96
Vel Total (ft/s)	7.24	Avg. Vel. (ft/s)	2.64	7.71	2.64
Max Chl Dpth (ft)	3.86	Hydr. Depth (ft)	0.28	2.80	0.28

Plan: final plan River: haughey Reach:haughey Riv Sta: 0 Profile: PF 1 (Continued)

Conv. Total (cfs)	4430.8	Conv. (cfs)	66.9	4280.0	84.0
Length Wtd. (ft)		Wetted Per. (ft)	11.14	26.70	13.97
Min Ch El (ft)	950.70	Shear (lb/sq ft)	0.27	2.48	0.27
Alpha	1.10	Stream Power (lb/ft s)	0.72	19.14	0.72
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

APPENDIX B

INDIANA DEPARTMENT OF NATURAL RESOURCES

PATRICK R. RALSTON, DIRECTOR

Division of Outdoor Recreation
402 W. Washington St., Rm. 271
Indianapolis, Indiana 46204
317-232-4070

March 10, 1992

Mr. David Miller, P.E.
Harza Engineering
233 South Wacker Drive
Chicago, IL 60606-6392

RE: DNR #4437 - Water Quality Enhancement Project; Hamilton Lake, Steuben County

Dear Mr. Miller:

The Indiana Department of Natural Resources has reviewed the above referenced proposal and offers the following comments for your information.

Sites A, B, E, and G will require the formal approval of our agency for construction in a floodway, pursuant to the Flood Control Act (IC 13-2-22).

The Natural Heritage Program's data have been checked and, to date, no vulnerable plant or animal species of either state or federal significance have been reported to occur in the project vicinity.

The Division of Fish and Wildlife supports projects that benefit the public fresh water lakes, however, these projects should enhance fish and wildlife habitat where habitat per se does not exist.

Division of Fish and Wildlife staff inspected the project area on February 5, 1992. Mitigation will be required for those sites that impact wildlife habitat. Site specific comments include the following:

Site A: The division supports this site. The applicant should be aware that a dam is proposed approximately one mile upstream from Site A. It appears that this will decrease nutrient input to Hamilton Lake.

Site B: The division supports wetland restoration at this site.

Site E: A wooded corridor with existing wildlife habitat exists at this site. If possible, the division prefers that the site be left undisturbed.

Site F: Woody vegetation of benefit to wildlife exists at this site. Therefore, protection or minimization of impacts is recommended for this site.

Site G: Wetland exists at this site and should be left undisturbed.

Site H: The value or benefit of wetland restoration at this site is not apparent to the division.

It appears that land treatment practices constitute the most significant threat to the existing and future water quality of Hamilton Lake. Therefore, the Division of Fish and Wildlife recommends that these practices be addressed as to their relationship to water quality enhancement.

We appreciate this opportunity to be of service and apologize for not being able to respond to your inquiries sooner on this matter. If we can be of further assistance, please do not hesitate to contact Steve Jose at (317) 232-4070.

Sincerely,

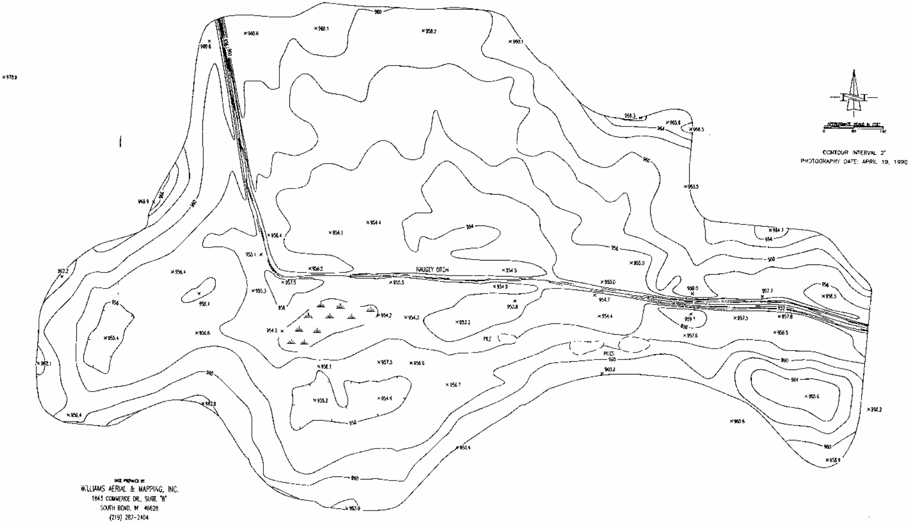
Patrick R. Ralston

Patrick R. Ralston, Director
Department of Natural Resources

PRR:SHJ

cc: Paul Glander, Division of Soil Conservation, Indianapolis, IN

APPENDIX C



DATE	HARZA	SITE PLAN	FIGURE
2/98		HAMILTON LAKE ENHANCEMENT PROJECT	1
PROJECT NO. 5257-0			

REPORT OF SUBSURFACE EXPLORATION

AND

LABORATORY TESTING

HAMILTON LAKE ENHANCEMENT PROJECT

WETLAND DESIGN SITES

HARZA ENGINEERING COMPANY

NOVEMBER 1991

TABLE OF CONTENTS

I. INTRODUCTION

Subsurface soil exploration and laboratory testing of soil samples were conducted in accordance with the Scope of Services in the Hamilton Lake Enhancement Revised Proposal for Phase II Services (Design), dated August 10, 1990. The results of the soil exploration and testing were used to determine criteria for use in the design of six artificial wetlands proposed for construction to enhance the water quality of Hamilton Lake.

The purpose of this report is to present, summarize, and interpret subsurface and laboratory information that has been gathered as a result of drilling and testing of selected soil samples.

II. FIELD WORK

Field work was conducted on July 30 & 31 and August 6 & 7, 1991. Harza's Mr. Carl M. Brown was responsible for making field observations and for logging boreholes and test pits.

Drilling was conducted by Raimonde Drilling Corporation, Inc., Chicago, Illinois, and test pits were excavated by Butler & Butler Construction, Inc., Auburn, Indiana. The subsurface exploration program is summarized below and in Table I.

At site A, which is located on Haughey Ditch (see Exhibit 1), two boreholes were drilled and two test pits were excavated. At site B, located on the Lillian Metz Ditch, upstream of the confluence of Burch Ditch, two test pits were excavated. At site E, located on Black Creek east of Highway 1, two borings were made and one test pit was excavated. At site F two test pits were excavated. At site G, located east of the sand and gravel pit operated by Flegal Sand & Stone Company, three soil borings were made. At site H, located across the county road west of site G, one test pit was excavated.

Table I - Hamilton Lake Enhancement Project
Summary of the Subsurface Exploration Program

Site	Soil Borings	Location	Dates	Test Pits	Location	Dates
A	Two: AB1	Rt. Abut.	8/7	Two: AT1	Rt. side	7/31
	AB2	Lt. Abut.	8/7	AT2	Rt. side	7/31
B	None			Two: BT1	At dam	7/31
				BT2	Rt. side	7/31
E	Two: EB1	Lt. Abut.	8/7	One: ET1	Lt. side	7/31
	EB2	At dam	8/7			
F	None			Two: FT1	Lt. Abut.	8/7
				FT2	Center	8/7
G	Two: GB1	Lt. Abut.	8/6	None		
	GB2	Dam Cntr.	8/6			
	GB3	Rt. Abut.	7/30			
H	None			One: HT1	D/S dam	7/31

All borings were advanced using 4-1/2" I.D. hollow stem augers powered by a CME 55 track mounted drill rig. Samples were obtained at 2-1/2 foot intervals by split spoon sampling according to ASTM D-1286. Representative samples were placed in glass jars and retained by Harza for testing in Harza's soil laboratory.

Insitu shear strength was measured in the field using a pocket penetrometer and a hand torvane shear strength test kit.

III. LABORATORY TESTING

Laboratory testing included Atterberg Limits, gradation analysis, visual classification, and standard Proctor for selected samples. The laboratory testing program is summarized on Table II below.

Table II - Hamilton Lake Laboratory Soil Testing Program

Site	Sample	Atterberg Limits	Gradation	Moisture Content	Standard Proctor
Site A	AB1-S1	xx	xx	xx	
Site A	AB1-S2	xx	xx	xx	
Site A	AB2-S1	xx	xx	xx	
Site B	BT1-S1	xx	xx	xx	
Site B	BT2-S2	xx	xx	xx	
Site B	Creek	xx	xx	xx	
Site E	EB1-S1		xx	xx	
Site E	EB1-S3		xx	xx	
Site E	EB1-S5		xx	xx	
Site E	EB2-S1	xx	xx	xx	
Site E	EB2-S2	xx	xx	xx	
Site E	EB2-S3	xx	xx	xx	
Site E	ET1-S2		xx	xx	xx
Site E	Creek		xx	xx	
Site F	FT1-S1	xx	xx	xx	
Site F	FT1-S2		xx	xx	
Site F	FT2-S1	xx	xx	xx	
Site F	FT2-S2	xx	xx	xx	
Site F	FT2-S3		xx	xx	xx
Site G	GB1-S1		xx	xx	
Site G	GB1-S2		xx	xx	
Site G	GB1-S3	xx	xx	xx	
Site G	GB3-S6		xx	xx	
Site H	HT1-S2	xx	xx	xx	xx
Site H	Creek	xx	xx	xx	
Total		15	25	25	3

IV. SUMMARY OF FIELD AND LABORATORY RESULTS

SITE A. At Site A, soil borings were located on either side of the proposed dam, and two test pits were excavated within the proposed wetland area (see Exhibit 2). The upper 8-10 feet of soil is stiff silty clay with some sand (CL) or stiff clayey silt (ML). Below the silty clay lies gray clay (CL). The gray clay includes a two foot thick soft layer which lies above and below a very thin (2-4 inches thick) coarse sand layer which is located approximately at the depth of the water table. Below the soft layer, the gray clay becomes medium to hard.

Gravelly clay was encountered at a depth of about 18 feet beneath the proposed right abutment, and gravelly clayey sand was found at a depth of 4.5 feet in one of the test pits. The gravelly layers do not appear to be continuous and contain at least 40% fines. Seepage under the embankment dam along gravel layers is unlikely and a seepage cut-off is not necessary.

Excavation of a grass channel spillway or of a deep pool to increase sediment trapping efficiency upstream of the dam will provide suitable embankment fill material. The natural moisture content of the upper 5 feet of soil is below the plastic limit, therefore, preliminary indications are that excavation and compaction of this material will not be a problem during construction.

SITE B. Two test pits were excavated at Site B in the vicinity of the proposed wetland (see Exhibit 3). The soil, to a depth of about 12 feet, varies between silty clay (CL) and clayey silt (ML). Some sand lenses were found, however, they were discontinuous within the test pits.

The moisture content of the upper few feet of soil is below the plastic limit, therefore, no problems should be encountered in working the soil during construction.

SITE E. Two soil borings and one test pit were conducted at Site E. One soil boring was located on the left abutment of the proposed dam and the other was located in the bed of Black Creek upstream of the proposed dam (see Exhibit 4). The test pit was located above the Black Creek flood plain to the left and upstream of the proposed dam.

The left abutment, to a depth of about 10 feet, is silt (ML), silty sand (SM), and gravelly silt (GM). From 10-11 feet, there is a layer of well-graded quartz sand (SW). Below the sand layer the soil is gravelly sand and gravelly sand with some clay clasts to a depth of about 15 feet at which depth the soil is again silt and silty sand. The uncorrected SPT blowcount values (N) are high, ranging from 14 to 34, therefore, the abutment is relatively dense.

The existing creek bed has a layer of gravel about three inches thick which overlies gravelly silty sand (SM) to a depth of about eight feet. From depths of 8-13 feet, the soil is hard gray clay (CL). The foundation soil should have adequate bearing capacity as evidenced by the uncorrected SPT blowcount values.

In the location of the test pit, the topsoil was 1.5 feet thick. Below the topsoil was a layer of gray medium to hard silty clay (CL) extending to a depth of 5 feet followed by a gray clay (CL) to a depth of 6.5 feet. From 6.5 feet to the bottom of the test pit (11 feet deep) was a layer of silty sandy gravel with some cobbles (GP-GM). The water table was at a depth of about 7.5 feet. The gravel was probably deposited along Black Creek before the creek eroded down to its present level. The gravel is similar to existing gravel along the present creek bed and has a high permeability as evidenced by the rate that water entered the test pit. The existence of a continuous gravel layer within the foundation material below the dam indicates that consideration should be given to design of a seepage cutoff beneath the proposed structure.

SITE F. Two test pits were excavated at Site F, one located at the location of the proposed left abutment and the other in the center of the proposed wetland (see Exhibit 5).

At the location of the left abutment, the soil is clayey sand, silty sand and gravelly clayey sand (SC) to a depth of about 5 feet. From 5-7 feet in depth, the soil is poorly graded sand with some silt (SP). From 7-12 feet, the soil is gravelly sand with clay clasts.

In the center of the wetland site the existing topsoil is over three feet thick and is dark brown, organic, silty sand. Below the topsoil is medium gray clay and clayey gravel.

SITE G. Site G is an existing emergent wetland, therefore, to minimize preconstruction impact, no test pits were excavated. The three borings conducted at the site are adequate to define the soil layer types and thicknesses.

There is a layer of soft, black silty organic soil up to 11 feet thick deposited throughout the site from abutment to abutment. The boring on the left abutment, however, was located on a bench midway up the abutment and was above the contact between the black organic soil and the underlying silty sand (see Exhibit 6).

The left abutment and the soil beneath the organic soil is predominately silty sand (SM). However, there is a clayey sand layer from about 10-14 feet in depth at both the left abutment and right abutment, and some gravels with the sand below the clayey sand at the right abutment.

The uncorrected SPT blowcount values ranged from 8 to 13 in the left abutment. The abutment should provide an adequate foundation for the proposed box-culvert spillway. Consideration should be given to removal of the thick organic foundation material or to improving the material's stability by preloading and consolidation. To verify that there is adequate lateral area on the left abutment for construction of the box-culvert spillway, a hand auger boring program is recommended to further define the contact between the soft black topsoil and the silty sand foundation soil.

SITE H. The test pit excavated at Site H revealed that the creek bank at the test pit location consists of silty organic topsoil and sandy silty clay to a depth of about four feet followed by a silty sand layer (SM) at least 10 feet thick.

The test pit was located on the left bank about 200 feet downstream of the existing berm at Site H (see Exhibit 7). If the proposed dam is to be located downstream of the existing berm, the upper sandy silty clay is suitable for embankment fill material while the silty sand is adequate for the spillway foundation.

If the existing berm is utilized as the lower half of the embankment dam, then a hand auger boring program is recommended to further define the foundation soils at the right abutment and the existing fill in the berm.

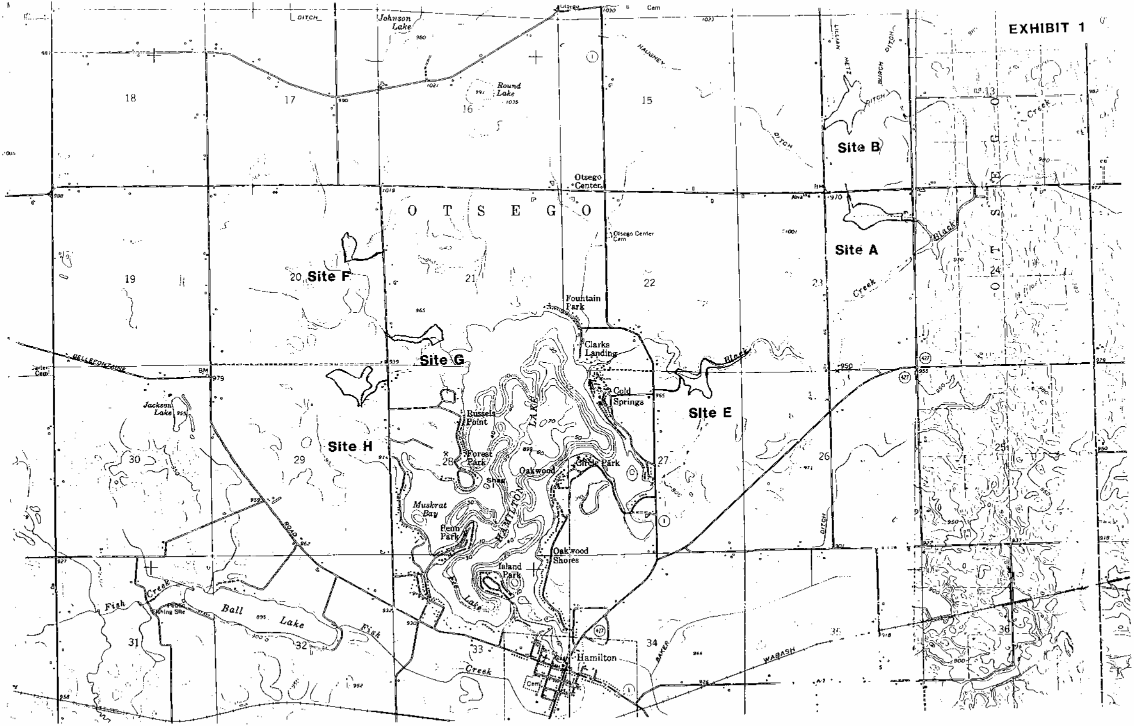
V. CONCLUSION

The exploration program which was conducted at the proposed wetland sites should be adequate for the design and construction of wetlands in Sites A - F. The field exploration and laboratory testing programs have revealed information regarding the soil layers and construction materials at the wetland sites. The foundation conditions at the sites are well defined and suitable material for fill has been located.

Additional information may be required for Site G and Site H. If necessary, a program of hand auger exploration developed on the basis of design requirements should be sufficient to supplement the existing data.

EXHIBITS

EXHIBIT 1



Site A
Site B
Site E
Site F
Site G
Site H
O T S E G O
Otsego Center
Otsego Center Cem
Johnson Lake
Round Lake
Jackson Lake
Fountain Park
Clarks Landing
Cold Springs
Russels Point
Forest Park
Oakwood
Circle Park
Muskrat Bay
Penn Park
Hamilton Lake
Oakwood Shores
Island Park
Ball Lake
Fish Creek
Black Creek
Public Fishing Site
Hamilton
Bellefontaine
Road
Wabash
Baker
Ditch
Cem
13
15
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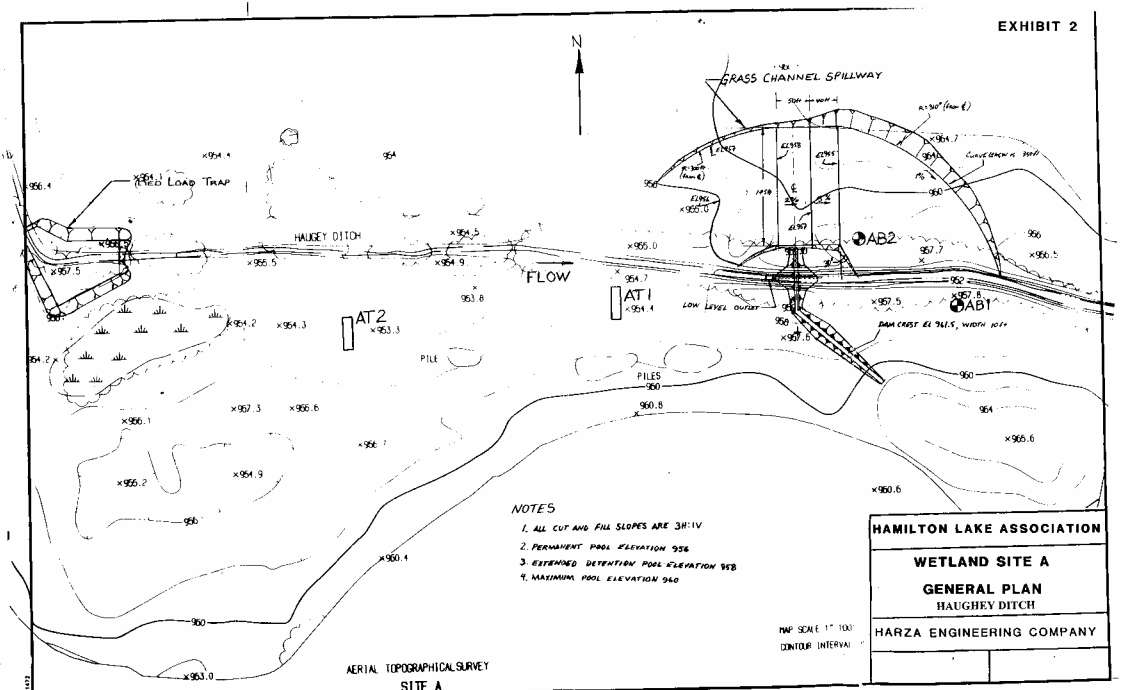
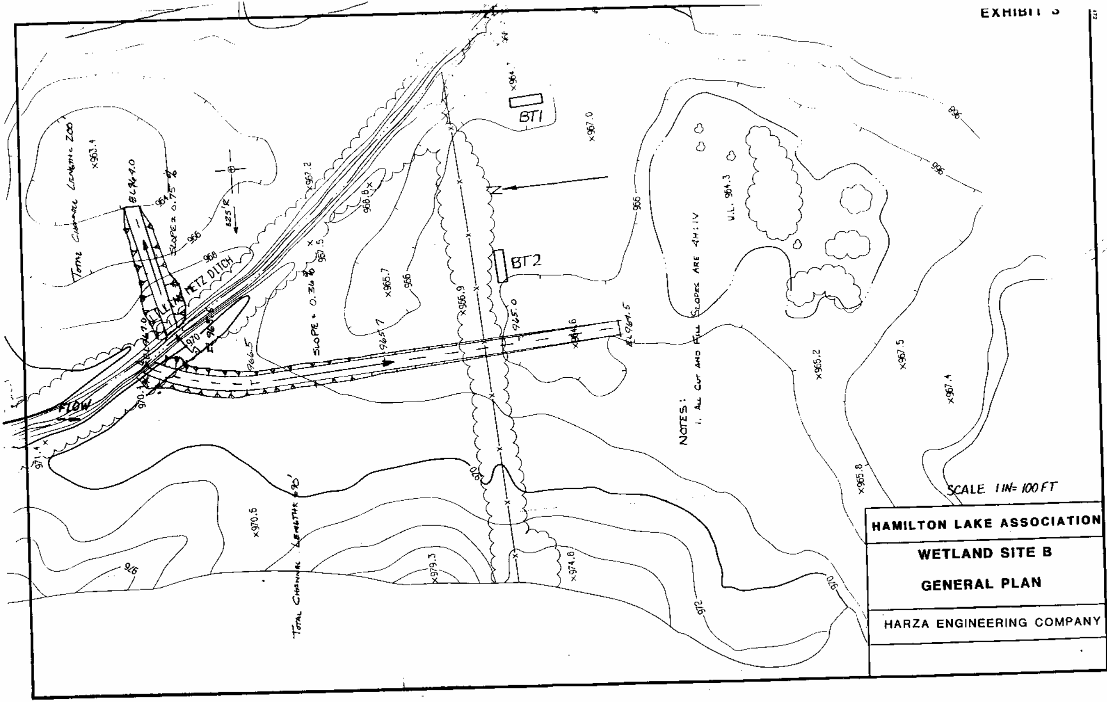
36

EXHIBIT 2



HAMILTON LAKE ASSOCIATION
WETLAND SITE A
GENERAL PLAN
HAUGHEY DITCH
HARZA ENGINEERING COMPANY

EXHIBIT 3



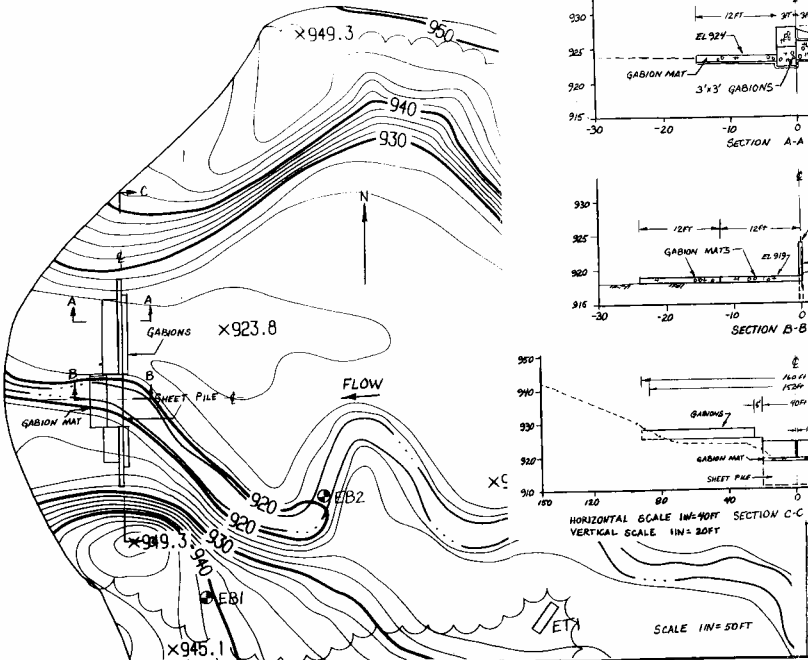
HAMILTON LAKE ASSOCIATION

WETLAND SITE B

GENERAL PLAN

HARZA ENGINEERING COMPANY

EXHIBIT 4



SCALE 1IN=50FT

HAMILTON LAKE ASSOCIATION

WETLAND SITE E
PLAN AND SECTIONS

HARZA ENGINEERING COMPANY

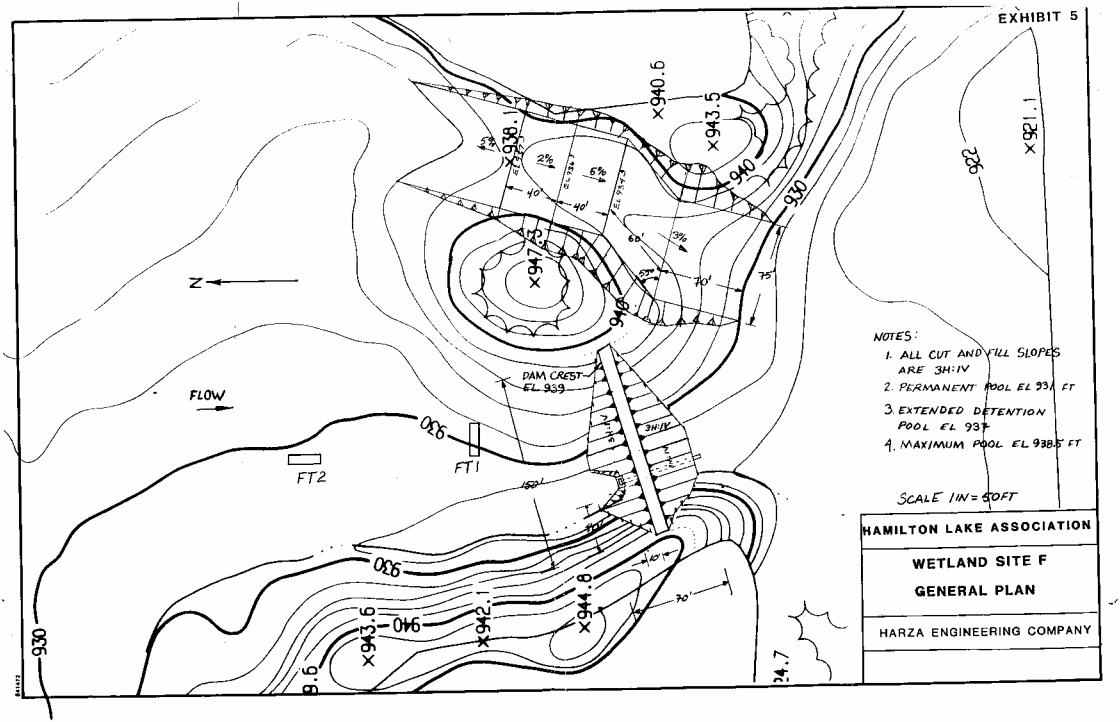


EXHIBIT 5
N
FLOW
FT1
FT2
DAM CREST EL 939
940.6
943.5
938.1
947.3
921.1
944.8
942.1
943.6
930
940
NOTES:
1. ALL CUT AND FILL SLOPES ARE 3H:1V
2. PERMANENT POOL EL 931 FT
3. EXTENDED DETENTION POOL EL 937
4. MAXIMUM POOL EL 938.5 FT
SCALE 1IN = 50FT
HAMILTON LAKE ASSOCIATION
WETLAND SITE F
GENERAL PLAN
HARZA ENGINEERING COMPANY

EXHIBIT 6

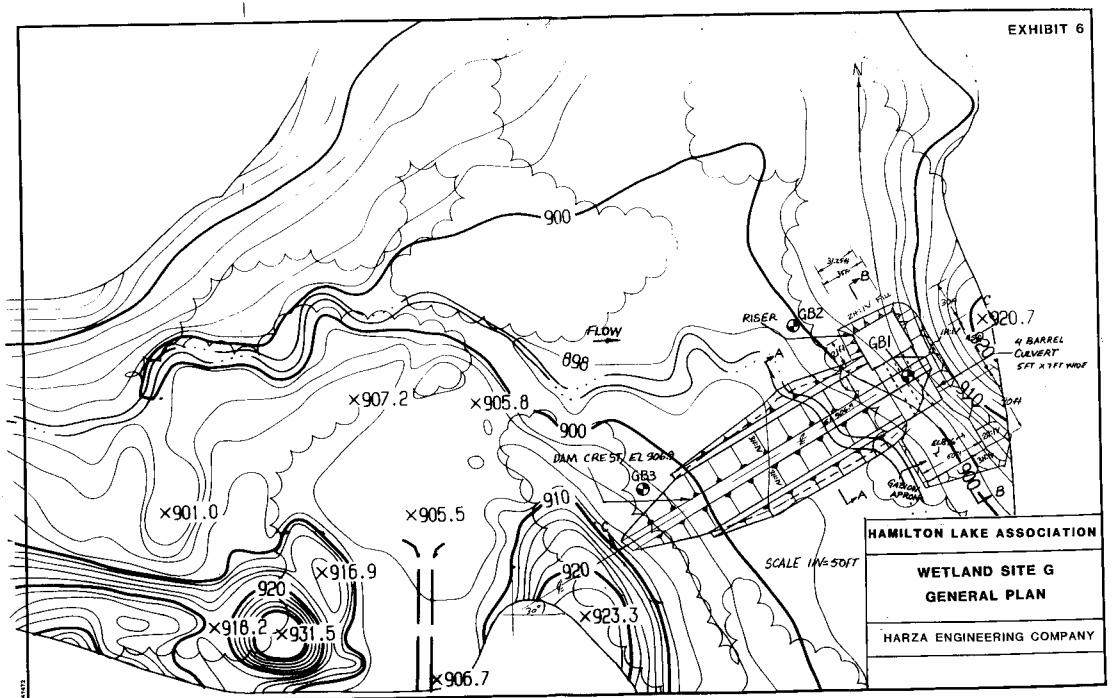
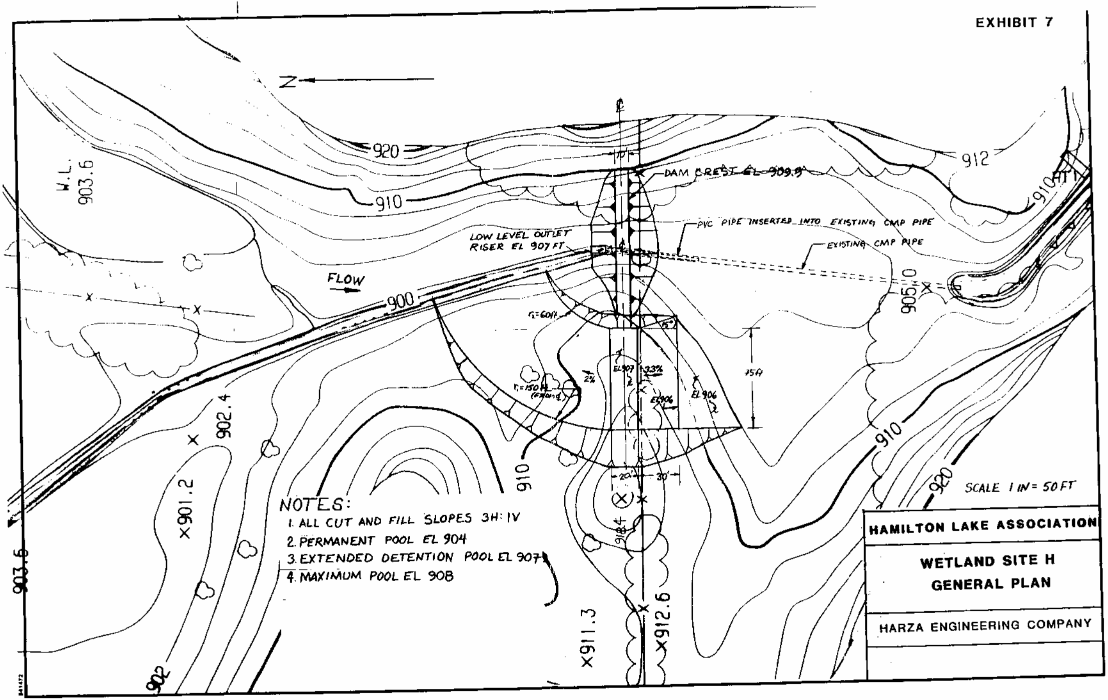

N
900
FLOW
898
×907.2
×905.8
900
DAM CREST EL 906.8
GB3
910
×901.0
×905.5
×916.9
920
×918.2
×931.5
920
×923.3
×906.7
RISER
GB2
GB1
A
B
C
×920.7
4 BARREL CULVERT 5FT X 7FT WIDE
910
900
GABION APRON
LA
SCALE 1IN=50FT
HAMILTON LAKE ASSOCIATION
WETLAND SITE G
GENERAL PLAN
HARZA ENGINEERING COMPANY

EXHIBIT 7



NOTES:
1. ALL CUT AND FILL SLOPES 3H:1V
2. PERMANENT POOL EL 904
3. EXTENDED DETENTION POOL EL 907
4. MAXIMUM POOL EL 908

HAMILTON LAKE ASSOCIATION

WETLAND SITE H
GENERAL PLAN

HARZA ENGINEERING COMPANY

APPENDIX A - SOIL BORING LOGS

HARZA ENGINEERING COMPANY

Sheet 1 of 1

SOIL BORING LOG

Project Number 52576
Client HAMILTON LAKE ASSOC
Contractor RAIMONDE DRILLING
Drilling Method SPT
Hole Size 6" - 4½" ID Hollow Auger
Driller Phil Raimonde
Logged by CM BROWN, HARZA

Project Name HAMILTON LAKE

WATER LEVEL	10'		
TIME	430		
DATE	8/7		

Sample Hammer: Weight 140 lb
Drop 30 in
Sampler Dimensions 2ft Split spoon

Boring No. AB1
Location RT SIDE OF CREEK
~~Coordinates: N~~ AT SITE OF
E PROPOSED DAM
Ground Elevation 957
Total Depth 19 ft
Date Started 7/31/91
Date Completed 7/31/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0				5					edge of beanfield	
1		AB1 S1	SS	5 5		12"			tan clayey silt	
2										pocket penetrometer
3		S2	SS	7 8		18"			dry gray clay, some silt	>4.5 tsf >4.5 tsf >4.5 tsf
4				9						
5				8					dry very stiff silty clay	4.25 tsf
6		S3	SS	9 10		18"				4.25 tsf 4.25 tsf
7										
8		S4	SS	4 4		0"			no recovery.	
9				5						
10				3					Soft gray clay	1.0 tsf
11		S5	SS	7 7		18"			black pebble and sand	1.5 tsf 1.5 tsf
12									soft gray clay	
13		S6	SS	5 8		18"			stiff gray clay	>4.5 tsf
14				11						4 tsf 4.5 tsf
15				4				CL	med gray clay	
16		S7	SS	9 11		12"		SC	dk gray fine gravel and med-coarse SAND w/ clay matrix	
17										
18		S8	SS	14 14		15"			gray gravelly clay	
19				14					dk gray clayey, pebbley, SAND EOB — 19 feet	
20										

brown silty clay
gray clay with

HARZA ENGINEERING COMPANY

Sheet 1 of 2

SOIL BORING LOG

Project Number 52576
Client HAMILTON LAKE ASSOC.
Contractor RAIMONDE & SONS
Drilling Method SPLIT SPOON
Hole Size
Driller P. RAIMONDE
Logged by CMR

Project Name HAMILTON LAKE

WATER LEVEL	8½'	15'	
TIME	6PM	7PM	
DATE	8/7	8/7	

Sample Hammer: Weight 140/6
Drop 30 IN
Sampler Dimensions 2ft split spoon

Boring No. ABR
Location Left ABUTMENT
Coordinates: N
E
Ground Elevation 957 ft
Total Depth 24 ft
Date Started Aug 7, 1991
Date Completed 8/7/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									edge of beanfield	
1		S1	SS	4 4 6		12"			dk gray clayey silt	
2										
3		S2	SS	3 6 7		15"			red and gray mottled silty clay	Pocket Pen. 3.75 tsf
4										
5		S3	SS	5 9 9		10"			soft gray clay	1.75 tsf
6									gray coarse sand w clay + fine gravel	
7									soft gray clay	
8		S4	SS	14 15 15		15"			stiff gray clay med - soft gray clay ▽	4.5+ tsf 2 tsf
9										
10										
11		S5	SS	12 14 15		18"			soft gray clayey silt soft SANDY silt	1 tsf
12										
13		S6	SS	14 13 12		18"			gray stiff silty clay	4.25 tsf
14										
15									(water level after drilling)	
16										
17										
18		S7	SS	8 13 22		18"/24"			gray SANDY silty clay	4.5 tsf
19									gray clay	3.0 tsf 2.5 tsf
20										

HARZA ENGINEERING COMPANY

Sheet 2 of 2

SOIL BORING LOG

Project Number _____
Client _____
Contractor _____
Drilling Method _____
Hole Size _____
Driller _____
Logged by _____

Project Name _____

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight _____
Drop _____
Sampler Dimensions _____

Boring No. AB2
Location _____
Coordinates: N _____
E _____
Ground Elevation _____
Total Depth _____
Date Started _____
Date Completed _____

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
20										
21										
22										
23		SB	SS	10		14"			gray hard silty clay	> 4.5 tsf
24				13						> 4.5 tsf
				22					EOB 24 ft.	4.0 tsf

HARZA ENGINEERING COMPANY

Sheet 1 of 2

SOIL BORING LOG

Project Number 52571 Project Name HAMILTON LAKE EXH. Boring No. EB-1

Client HAMILTON LAKE ASSOC. Location LOT 2 ADJUSTMENT

Contractor RAIMONDE & SONS Coordinates: N ____ E ____

Drilling Method SPLIT SPOON

WATER LEVEL	22'		
TIME	2:00 PM		
DATE	8/7		

Hole Size 4¼ IN ID Hollow Auger Sample Hammer: Weight 140 lb Ground Elevation 940 ft

Driller P. RAIMONDE Drop 30 IN Total Depth 24 ft

Logged by C M B Sampler Dimensions 2 IN Split Spoon Date Started 8/7/91

Date Completed 8/7/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									Raspberry Fen	
1		S-1	SS	8 15 16	18"	10"	0'	ML	6" layer organic sandy silty soil / brown dry silt with some-trace gravel	
2										
3		S2	SS	18 15 12	18"	0"	2.5'		may have pushed gravel	
4										
5		S3	SS	9 7 7	18"	10"	5'	GM	lt brown to white, gravel and silt some SAND gravel is sub ROUNDED	
6										
7										
8		S4	SS	16 13 14	18"	14"	7.5'	ML	yellow dry silt	
9									augered thru gravel	
10		S5	SS	8 8 8	18"	16"	10		gray/white fine gr SAND	
11									lt gray fine gravelly med to coarse SAND subangular to sub rounded fine gravel	
12										
13		S6	SS	17 7 7	18"	18"	12.5'	SC	brown fine gravelly med to coarse SAND w/ clay clasts AND some clay matrix	
14									cobbles or gravel	augered thru
15										
16									yellow silt	
17										
18		S7	SS	16 13 13	18	15"	17.5'	ML SM	yellow silty SAND w/ silt lense 2" thick	
19										

HARZA ENGINEERING COMPANY

Sheet 2 of 2

SOIL BORING LOG

Project Number _____
Client _____
Contractor _____
Drilling Method _____
Hole Size _____
Driller _____
Logged by CMB

Project Name _____

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight _____
Drop _____
Sampler Dimensions _____

Boring No. EB1
Location Left abutment
Coordinates: N _____
E _____
Ground Elevation _____
Total Depth _____
Date Started _____
Date Completed _____

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
20				13					white SANDY SILT	
21		58	SS	16	18	12"			white silty SAND	
22				18					▽	
23		59	SS	12	18	12'			white silty fine SAND	
24				14					EOB 24'	
				17						
25										

HARZA ENGINEERING COMPANY

Sheet 1 of 1

SOIL BORING LOG

Project Number 52575
Client HAMILTON LAKE ASSOC
Contractor RAYMONDE DRILLING
Drilling Method SPT
Hole Size 6IN.
Driller P. RAYMONDE
Logged by CMB, HARZA

Project Name HAMILTON LAKE

WATER LEVEL	4ft		
TIME	3pm		
DATE	8/7/91		

Sample Hammer: Weight 140 lb
Drop 30 IN
Sampler Dimensions 2in Split spoon

Boring No. EB 2
Location stream bed NE of Mt. Lake
Coordinates: N
E
Ground Elevation 920 ft
Total Depth 14 ft
Date Started Aug 7, 1991
Date Completed Aug 7, 1991

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									3IN gravel in stream bed	
1	1	EB2 S1	SS	1	18"	10"		SC	brown SANDY clay	
	9			9						
	7			7						
2										
3		S2	SS	10	18"	12"			yellow Sandy clay w/ gravel	
				13						
4				13					▽	
5									saturated sandy clay	
		S3	SS	10						
6				10	18"	12"				
				9						
7									black silty fine SAND to fine gravel shale flakes w/ some sand	
8		S4	SS	15						
				11	18"	12"			gray hard clay	Pocket penetrometer 4.5 tsf 4.0 tsf 4.5 tsf average ~ 4
9				11						
10										
		S5	SS	12					clay must have remained in hole	
11				15	18"	0"				
				19						
12										
				6					half of sample gray clay half brown SANDY clay	Pocket 3.5 tsf 3.5 tsf 4.0 tsf
13			SS	8	18	18"				
				9						
14									gray silt	Pocket penetrometer 1 tsf 1 tsf 1 tsf
									EOB — 14ft	
15										
16										
17										
18										
19										

HARZA ENGINEERING COMPAN

Sheet 1 of 3

SOIL BORING LOG

Project Number 52576
Project Name HAMILTON LAKE
Client HAMILTON LAKE ASSOC
Contractor
Drilling Method Split Spoon & Hollow Stem Auger
Hole Size
Driller Phil RAIMONDE
Logged by CM BROWN

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight 140 lb
Drop 30 IN
Sampler Dimensions 2 IN split spoon

Boring No. GB-1
Location Left abutment
Coordinates: N (Proposed)
E
Ground Elevation 904
Total Depth 24 ft
Date Started 8/6/91 4:30-6PM
Date Completed 8/6/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0				3					oak trees adjacent to boring, grass + other veg little to no topsoil	
6"		GB1								
1		S1	SS	5	18"	18"		SM	dry yellow silty, fine SAND	
				7						
2										
		GB1		12						
3		S2	SS	6	18"	18"		SM	moist yellow silty, fine Sand	
				5						
4										
5				3						
		S3	SS	3	18"	18"		SM	gray clayey 5% silty 10% SAND sand is MORE coarse fine mixed.	
6				6						
7										
				7						
8		S4	SS	4	18"	8"		SM	gray silty Sand (fine to coarse SAND)	
				4						
9										

...ING COMPANY

SOIL BORING LOG

Project Number
Client
Contractor
Drilling Method
Hole Size
Driller
Logged by CMB

Project Name

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight
Drop
Sampler Dimensions

Boring No. GB1
Location
Coordinates: N
E
Ground Elevation
Total Depth
Date Started
Date Completed

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
10				6					dark gray saturated clayey SAND	
11		S5	SS	6	18"	14		SC		
				5						
12										
				14						
13		S6	SS	6	18"	14			gray saturated clayey SAND	
14				5					soft brown silty fine sand	
									- - - - - - -	
15				10					Gray fine silty SAND	
		S7	SS	6	18"	16"			pungent odor	
16				7						
17										
				15					gray silty fine to coarse SAND	
18		S8	SS	7	18"	15"			= thin stack, clayey, silty, fine sand layer =	
				6					gray silty fine to coarse SAND	
19										
20										

HARZA ENGINEERING COMPANY

Sheet 3 of 3

SOIL BORING LOG

Project Number _____
Client _____
Contractor _____
Drilling Method _____
Hole Size _____
Driller _____
Logged by _____

Project Name _____

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight _____
Drop _____
Sampler Dimensions _____

Boring No. GB1
Location _____
Coordinates: N _____
E _____
Ground Elevation _____
Total Depth _____
Date Started _____
Date Completed _____

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
20				14						
		S1	SS	6	18"	12"		SM	gray silty, fine to coarse SAND w/ small shale pebbles	
21				5						
22										
23		S2	SS	7	18"	12"		SW	clean gray fine to coarse SAND	
				6						
24				6					EOB 24ft	

HARZA ENGINEERING COMPANY

Sheet 1 of 2

SOIL BORING LOG 3

Project Number 52571
Client HAMILTON LAKE ASSOC.
Contractor RAIMONDE DRILLING
Drilling Method SPLIT SPOON
Hole Size
Driller PHIL RAIMONDE, SCOTT
Logged by CARL M BROWN

Project Name HAMILTON LAKE

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight
Drop
Sampler Dimensions

Boring No. GB-2
Location SITE G, CENTER
Coordinates: N
E
Ground Elevation 899
Total Depth 15.5
Date Started 8/6/91 3-4:30 PM
Date Completed 8/6/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									4ft grass AND VEGETATION	
6"		GB2		4		0"	4½		black organic matter root bound.	
1'		S1	SS	1	18	only in sampler tip				
2										
3		GB3	SS	1/18"	18	0"			No sample recovered	
4		S2								
5										
6		S3	SS	1/12"	18	0" only in sampler tip			sample in tip was green/ black organic residue w/ some med sand. sample was soft as sour cream.	
7				1/6"						
8		S4	SS	1/12"	18	1"			water washed sample out of split spoon. sample in tip was dk gray silty, clayey, fine SAND with roots AND organic matter	
9				1/6"						
10										

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Sheet 2 of 2

SOIL BORING LOG

Project Number

Client

Contractor

Drilling Method Split spoon SAMPLER w/ 4½" ID Hollow Auger

Hole Size

Driller P.R.

Logged by CMB

Project Name

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight

Drop

Sampler Dimensions

Boring No. GB-2

Location SITE G, CENTER

Coordinates: N

E

Ground Elevation

Total Depth 15½

Date Started

Date Completed

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
10				1/12"					black organics	
11		S5		5/12" 6	18	8"			grey silty 5% poorly graded very fine - fine sand.	
12										
13		S6		3 3 6	18	16			gray silty, very fine - fine SAND	
14		S7		3 6 10	18	14			gray very fine to med SAND	
15									EOB 15.5ft	

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SOIL BORING LOG

Project Number 52579
Project Name HAMILTON LAKE
Client HAMILTON LAKE
Contractor RAIMONDE
Drilling Method SPLIT SPOON
Hole Size 4¼ ID
Driller PHIL R. + Sc[illegible]
Logged by C. [illegible]

WATER LEVEL	6	14	
TIME	3PM	5pm	
DATE	7/30/91	7/30	

Sample Hammer: Weight 140 lb
Drop 30 IN
Sampler Dimensions 2 IN split spoon

Boring No. GB-3
Location R[illegible] ABUTMENT
Coordinates: N
E
Ground Elevation [illegible] ft
Total Depth 24
Date Started July 30, 1991 2:30pm
Date Completed

Surface Conditions:

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
0									DENSE VEGETATION, Raspberry AND OTHER 3-4 ft TALL (moss)	
½ – 1½	0 – 1½	GB3-SS1	SS	1, 1, 0	18	0			No RECOVERY – very soft black soil	
2										
3 – 4	2½ – 4	GB3-SS2	SS	1, 1, 1	18	2"			very soft black soil	
4									Well ROUNDED fine SAND, SILT – lt grey with some clay	
5 – 6	5 – 6½	GB3-SS3	SS	1, 1, 1	18"	14"			soft black ORGANIC matter soft SPONGEY RED BROWN + BLACK	WATER
7									(AUGER LIFTED SATURATED GREY SAND)	
8	7½ – 9	GB3-SS4	SS	0, 0, 2	18	13"			DK gray clayey organic soil; soft black organic matter	
9									SAND – fine to coarse gray SAND well ROUNDED	

HARZA ENGINEERING COMPANY

Sheet 2 of 3

SOIL BORING LOG

Project Number 5257 G

Client

Contractor

Drilling Method

Hole Size

Driller

Logged by

Project Name

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight

Drop

Sampler Dimensions

Boring No. GB-3

Location [illegible]

Coordinates: N

E

Ground Elevation

Total Depth

Date Started

Date Completed

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
10				23					gray clay with organics	
		4	SS	11	18	18"			fine to coarse SANDY clay - yellow color	
11		5		8					yellow clayey, silty, fine to coarse SAND	
									gravelly yellow SAND in spoon tip	
12										
				5						
13		6	SS	15	18	18"			sandy clay some organics	
				13					yellow gravelly med-coarse SAND	
14										
15				12		18"				
		7	SS	18	18				lt grey-yellow gravelly sand w/ clay matrix	2 samples
16				9					yellow, dense clay	
17										
									fine - med gravel sub angular to well rounded	
18		8	SS	18	18	16"			gravelly sandy clay	
				11						
				8					orange med-course well rounded sand	
19										
20										

HARZA ENGINEERING COMPANY

Sheet 3 of 3

SOIL BORING LOG

Project Number _____
Client _____
Contractor _____
Drilling Method _____
Hole Size _____
Driller PHIL RAIMONDE
Logged by C M BROWN

Project Name HAMILTON LAKE

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight _____
Drop _____
Sampler Dimensions _____

Boring No. GB-3
Location _____
Coordinates: N _____
E _____
Ground Elevation _____
Total Depth _____
Date Started _____
Date Completed _____

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
20				12					med-coarse rounded SAND	
		SS-9		14						
21				14						
									coarse silt to fine sand very well rounded	
22										
				11					COARSE SAND	
23		SS-10		9					YELLOW SAND w/ some silt and clay	
				11					& clay, fine-med SAND	
24									EOB 24 ft	
25										
									AT COMPLETION OF DRILLING WATER LEVEL AT 14 ft	

APPENDIX B - TEST PIT LOGS

HARZA ENGINEERING COMPANY

TEST PIT ~~SOIL BORING~~ LOG

Sheet 1 of 1

Project Number 52576
Client HAMILTON LAKE ASSOC
Contractor BUTLER + BUTLER
Drilling Method BACKHOE
Hole Size
Driller JOE RICHMAN
Logged by CM BROWN

Project Name Hamilton Lake

WATER LEVEL	8'		
TIME	10 AM		
DATE	7/31/91		

Sample Hammer: Weight —
Drop —
Sampler Dimensions

Boring No. AT 1
Location BELOW RT SEDIMENT
Coordinates: N
E
Ground Elevation 954.5 ft
Total Depth 11
Date Started 7/31/91
Date Completed 7/31/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									no vegetation, bears nearby	
1									dk gray topsoil	
2									ML-CL	
3	X	AT1-S1	BS						mottled yellow/gray silty clay.	X SAMPLE
4										
5									gravelly, clayey, silty sand	
6									20% 20% 20% 40%	
7	X								gravel up to 1½ inch - 2 inch	X SAMPLE
8		AT1	BS						▽	
9										
10									gravelly clayey fine-coarse sand	
11									15% 25% 60%	
									EOT Test Pit	

HARZA ENGINEERING COMPANY

~~SOIL BORING~~ TEST TRENCH LOG

Sheet 1 of 1

Project Number 5257 G
Client HAMILTON LAKE ASSOC.
Contractor BUTLER & BUTLER
Drilling Method BACK HOE
Hole Size 7FT x 10FT x 14 FT
Driller BOB RICHMAN
Logged by C M BROWN

Project Name ~~HAMILTON LAKE~~

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

~~Boring~~ No. AT 2
Location SITE A, HAZEL DELL
Coordinates: N WEST OF RIDGE
E
Ground Elevation 953.3
Total Depth 14 FT
Date Started JULY 31
Date Completed JULY 3'

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									NO VEGETATION AT TEST PIT SITE, SAME GRASS NEARBY	
1		AT2-S1	BS						DENSE BLACK ~~L~~ layey TOPSOIL	X Sample
2									▽	
3									gray clay MED density	
4										
5		AT2-S2	BS							X SAMPLE
6								CL	med gray clay	
7										
8										
9										
10										
11								SC	gray sandy clay	
12										
13		AT2-S3	BS					SP	gray well graded CLEAN fine to med well ROUNDED SAND.	X Sample
14										

HARZA ENGINEERING COMPANY

Sheet 1 of 1

SOIL BORING LOG

Project Number 5257G
Client HAMILTON LAKE ASSOC.
Contractor BUTLER & BUTLER
Drilling Method BACKHOE
Hole Size —
Driller BOB RICHMAN
Logged by CM BROWN

Project Name HAMILTON LAKE

WATER LEVEL	6		
TIME	11		
DATE	7/31		

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. BT-1
Location RT SIDE OF CREEK
Coordinates: N —
E —
Ground Elevation 965 Ft
Total Depth 13 Ft
Date Started July 31
Date Completed July 31

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									depression, sparse vegetation	
1									dk gray topsoil	
2	X	S1							mottled red/dk gray clay very hard	similar material silty clay entire depth
3										
4	X	S2							Hard red/gray clay	
5										
6									RED BROWN clay	
7									silty clay	
8										
9									water seeped into hole at about 6 ft deep	
10										
11										
12	X	S3							gray clay	
13									EC TEST PIT	
14										
15										

HARZA ENGINEERING COMPANY

~~SOIL BORING~~ TEST PIT LOG

Sheet 1 of 1

Project Number 52576
Client HAMILTON LAKE ASSOC
Contractor BUTLER & BUTLER
Drilling Method BACKHOE
Hole Size —
Driller Bob RICHMAN
Logged by CMB

Project Name HAMILTON LAKE

WATER LEVEL			
TIME			
DATE			

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. BT-2
Location SITE B - CENTRAL PART
Coordinates: N along fence
E
Ground Elevation 966
Total Depth 13ft
Date Started 7/31/91
Date Completed 7/31/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									Trees + wild grapes along fence	
									black topsoil	
1										
2									layer or lense of gravelly (10%) silty clay	
3										
4					SAND LENSE poorly graded med sand					Discontinuous
5									dk gray hard silty clay	
6	X	S1	BS						SAND lense	
7	X	S2	BS						dk gray clayey silt	
8									to silty clay	
9										
10										
11										
12										
13									EO Test Pit 13ft	

HARZA ENGINEERING COMPANY

TEST PIT ~~SOIL BORING~~ LOG

Sheet 1 of —

Project Number 52576
Client HAMILTON LAKE ASSN
Contractor BUTLER + BUTLER
Drilling Method BACKHOE
Hole Size —
Driller Bob Richmar
Logged by CMB

Project Name Hamilton Lake

WATER LEVEL	7½'		
TIME	2 PM		
DATE	7/31		

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. ET 1
Location left side of creek
Coordinates: N —
E —
Ground Elevation 926
Total Depth 11 ft
Date Started 7/31
Date Completed 7/31/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
									tall grass + raspberry at edge of trees	
0									Top Soil, dk grey to black organic silty soil	
1										
2										
3								CL	grey med to hard silty clay	
4	X	ET1 S1	BS							
5										
6								CL	grey clay	
7									▽ silty sandy gravel w/ cobbles	
8	X	ET1 S2	large Bag Sample						material collapsed into test pit during excavation	
9										
10										
11									EOB - 11 ft	
12										
13										
14										
15										
16										

HARZA ENGINEERING COMPANY

~~SOIL BORING~~ TEST PIT LOG

Sheet 1 of 1

Project Number 52576
Client HAMILTON LAKE ASSOC
Contractor BUTLER + BUTLER
Drilling Method BACKHOE
Hole Size —
Driller BOB RICHMAN
Logged by CM BROWN

Project Name Hamilton Lake

WATER LEVEL	8 Ft		
TIME	8 Am		
DATE	8/7/91		

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. FT-1
Location SITE F
Coordinates: N —
E —
Ground Elevation 930
Total Depth 12 Ft
Date Started 8/7/91
Date Completed 8/2/91

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions: Photo 16	
0									Woodland vegetation, thorn bushes 4 ft tall	
1									dark brown topsoil, gravelly silty sand	Pocket pen. 3.25 tsf 4.25 tsf 4.5 tsf
2		FT1							dry lt brown silty SAND.	
3		S1	BS						red, very stiff gravelly SANDY clay	Torvane 6. Photo 15 7. 6.
4									lense of gravelly sand	
5									dry red brown silty SAND	
6		FT1 S2	BS						grey silty fine SAND	
7										
8								GC	gray clay clasts, yellow gravel and sand.	
9									gravel fine to 2 in dia.	
10										
11										
12									EOT — 12 ft	
13										

HARZA ENGINEERING COMPANY

~~SOIL BORING~~ TEST PIT LOG

Sheet 1 of 1

Project Number 5257 G
Client HAMILTON LAKE ASSOC.
Contractor BUTLER + BUTLER
Drilling Method BACK HOE
Hole Size —
Driller BOB RICHMAN
Logged by CM BROWN

Project Name HAMILTON LAKE

WATER LEVEL	8		
TIME	9AM		
DATE	8/2/91		

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. ET 2
Location CENTER OF SITE
Coordinates: N —
E —
Ground Elevation 930
Total Depth 12 Ft
Date Started AUG 7 1991
Date Completed Aug 2, 1991

Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									4ft high raspberry + other veg	
1		FT2							dk brown topsoil /	Torvane
2	X	S1	BS						organic silty SAND	4.3
3										5.0
4									gray clay, med to hard clay	3.0
5	X	FT2	BS							Pocket Pen
6	X	S2 S3	Large BAG SAMPLE							1.5
7										2.0
8									▽	2.5
9										Torvane PP
10										3.5 1.5
11									yellow brown gray clayey gravel, w/ silt	5.0 2.0
12									EOTEST PIT	Photo 19

HARZA ENGINEERING COMPANY

TEST PIT ~~SOIL BORING~~ LOG

Sheet 1 of 1

Project Number 52576
Project Name HAMILTON LAKE
Client HAMILTON LAKE ASS
Contractor BUTLER + BUTLER
Drilling Method BACKHOE
Hole Size —
Driller BOB RICHMAN
Logged by C M BROWN

WATER LEVEL	4:30	
TIME	6AM	
DATE	7/31/91	

Sample Hammer: Weight —
Drop —
Sampler Dimensions —

Boring No. HT-1
Location left side of creek
~~Coordinates:~~ N N/S of Dam
E
Ground Elevation
Total Depth 10ft
Date Started 7/31/91
Date Completed 7/31/91

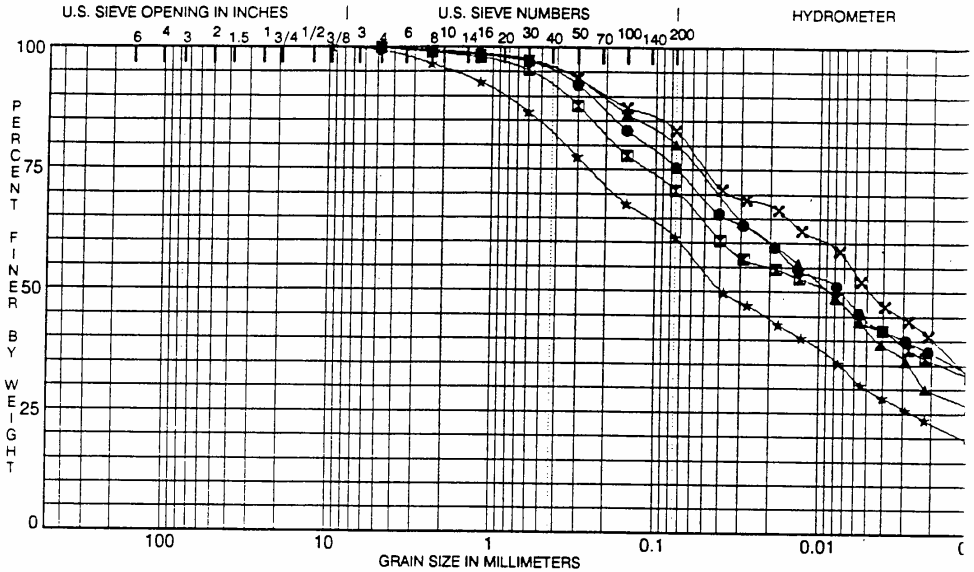
Depth (ft/m)	Sample Depth (ft/m)	Sample No.	Sampler Type	Blows per 6 in/15 cm	Length Driven (in/cm)	Length Recovered (in/cm)	Casing Depth (ft/m)	Unified Soil Classification	SOIL DESCRIPTION	NOTES AND FIELD TESTS
									Surface Conditions:	
0									grass	
1								ML	Dark brown Topsoil silty organics	
2										
3								CL	yellow/grey clayey sand	
4									Subangular silt to fine SAND	
5									yellow brown fine to med SAND	
6	X	HT S2	Large Bag Sample					SP		
7										
8									sand began to collapse into PIT.	
9										
10									EOB - 10ft	

APPENDIX C - GRAIN SIZE CURVES

HARZA

Job No. Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT -



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	MC%	LL	PL	PI	Cc	
●	AB1-S1	0.0	LEAN CLAY with SAND CL	15	35	22	13		
⊠	AB1-S2	0.0	LEAN CLAY with SAND CL	15	38	20	18		
▲	AB2-S1	0.0	SILT with SAND ML	20	41	27	14		
★	B-CREEK	0.0	SANDY LEAN CLAY CL	38	31	22	9		
✕	BT1-S1	0.0	SILT with SAND ML	26	41	33	8		

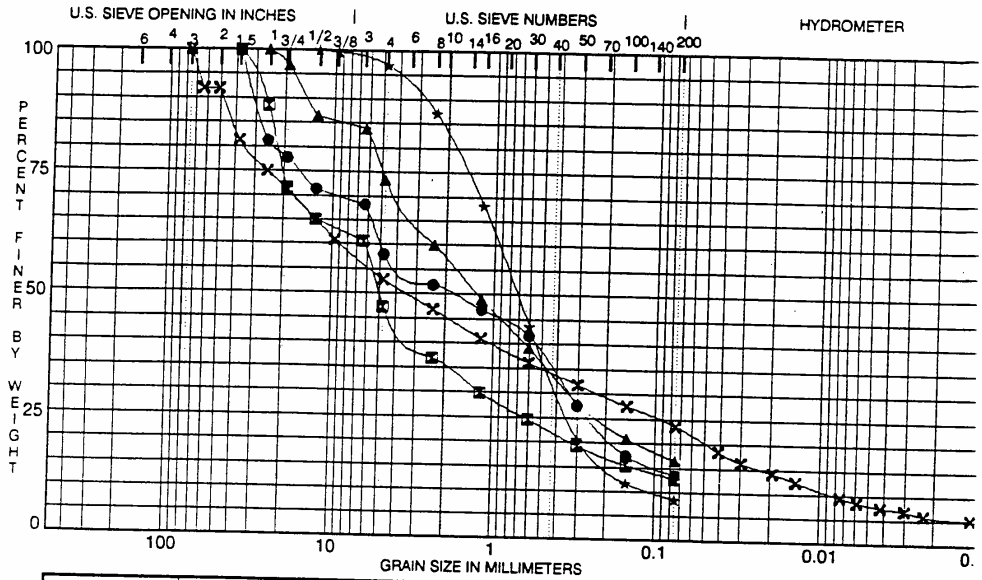
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Cl
●	AB1-S1	0.0	4.75	0.02			0.0	24.7	31.0	44.
⊠	AB1-S2	0.0	4.75	0.04			0.0	29.3	27.3	43.
▲	AB2-S1	0.0	4.75	0.02	0.002		0.0	19.9	37.9	42.
★	B-CREEK	0.0	9.50	0.07	0.005		0.6	38.4	31.0	30.
✕	BT1-S1	0.0	4.75	0.01			0.0	17.0	32.2	50.

GRADATION CURVES

HARZA

Job No. Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT -



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	C
● EB2-S1	0.0		20					
⧗ EB2-S2	0.0		8					
▲ EB2-S3	0.0		13					
★ EBI-S5	0.0		4				1.62	9.
✕ ET1-S2	0.0	SILTY GRAVEL with SAND GM	12	17	15	3		

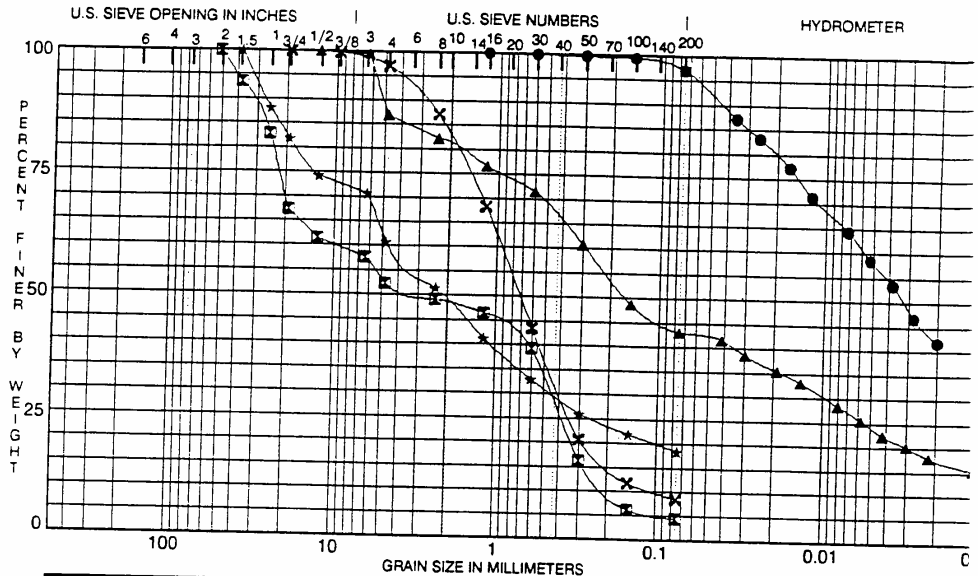
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● EB2-S1	0.0	37.50	5.02	0.339		42.0	44.5	13.5	
⧗ EB2-S2	0.0	37.50	6.21	1.192		52.8	34.5	12.7	
▲ EB2-S3	0.0	25.00	2.36	0.340		26.7	56.9	16.4	
★ EBI-S5	0.0	12.50	0.94	0.399	0.1038	3.0	88.5	8.5	
✕ ET1-S2	0.0	75.00	8.80	0.225	0.0083	47.2	29.2	15.5	8.1

GRADATION CURVES

HARZA

Job No.
Project **HAMILTON LAKE ENHANCEMENT -**

Date **9.9.91**



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Cc	C
● BT2-S2	0.0	LEAN CLAY CL	28	36	22	14		
■ E-CREEK	0.0		11				0.11	5(
▲ EB1-S1	0.0		7					
★ EB1-S3	0.0		4					
✕ EB1-S5	0.0		4				1.62	9

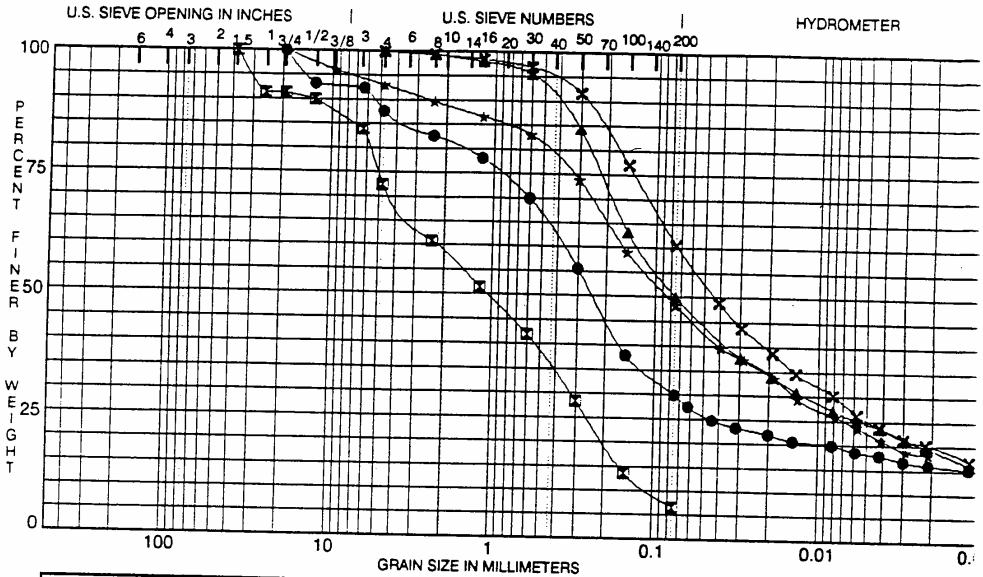
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Cla
● BT2-S2	0.0	1.18	0.01	0.001		0.0	3.0	39.4	57.6
■ E-CREEK	0.0	50.00	9.76	0.455	0.1952	47.6	47.9	4.5	
▲ EB1-S1	0.0	12.50	0.29	0.010		13.2	43.7	19.0	24.1
★ EB1-S3	0.0	37.50	4.51	0.450		39.3	42.3	18.4	
✕ EB1-S5	0.0	19.00	0.94	0.399	0.1038	3.0	88.5	8.5	

GRADATION CURVES

HARZA

Job No. Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT -



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

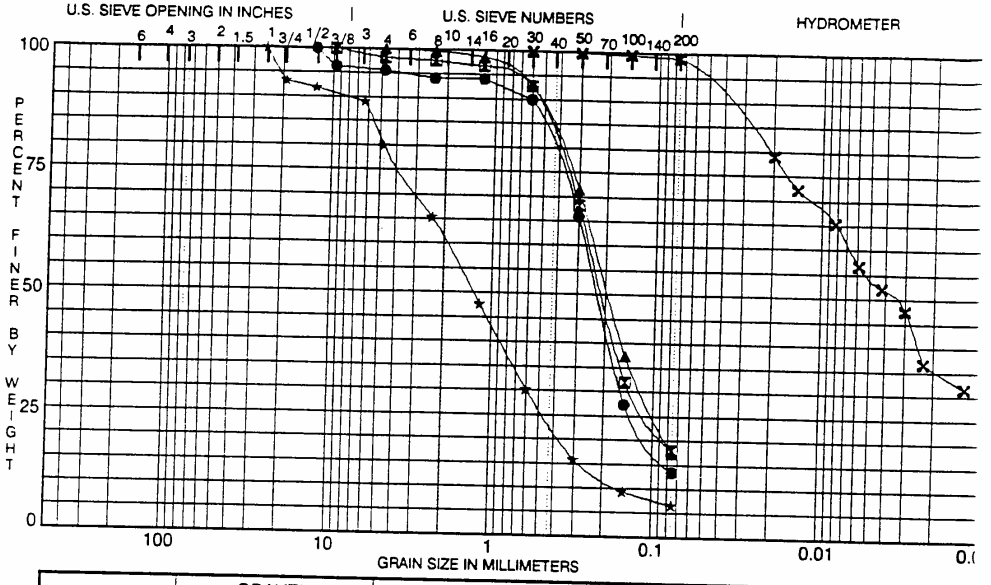
	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	FT1-S1	0.0	CLAYEY SAND SC	13	26	16	10		
⊠	FT1-S2	0.0		13				0.46	21.
▲	FT2-S1	0.0	SANDY SILT ML	20	25	23	2		
★	FT2-S2	0.0	CLAYEY SAND SC	19	28	16	12		
✕	FT2-S3	0.0	SANDY LEAN CLAY CL	15	27	20	7		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	FT1-S1	0.0	19.00	0.37	0.076		12.4	57.7	11.6	18.3
⊠	FT1-S2	0.0	37.50	2.21	0.327	0.1045	27.7	65.6	6.7	
▲	FT2-S1	0.0	4.75	0.13	0.012		0.0	50.0	25.6	24.4
★	FT2-S2	0.0	19.00	0.16	0.014		7.0	44.7	25.8	22.5
✕	FT2-S3	0.0	4.75	0.07	0.008		0.0	39.4	35.5	25.1

GRADATION CURVES

HARZA

Job No.
Date 9.9.91
Project HAMILTON LAKE ENHANCEMENT -



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	GB1-S1	0.0		3					
■	GB1-S2	0.0		6					
▲	GB1-S3	0.0		22					
★	GB3-S6	0.0		13				1.15	12.(
✕	H-CREEK	0.0	ELASTIC SILT MH	115	95	41	54		

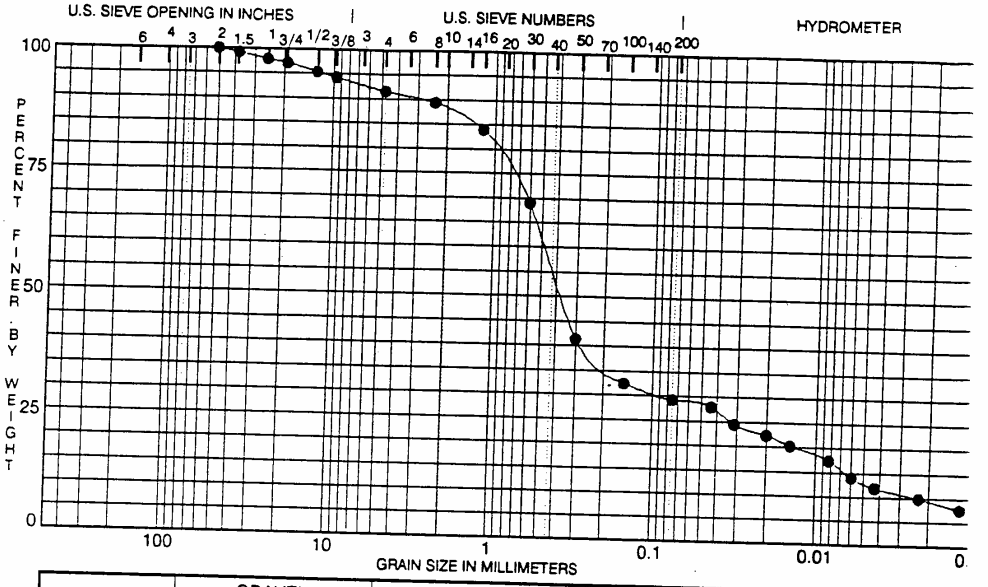
	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	GB1-S1	0.0	12.50	0.27	0.158		4.4	82.2	13.4	
■	GB1-S2	0.0	9.50	0.26	0.136		1.7	80.3	18.0	
▲	GB1-S3	0.0	4.75	0.24	0.117		0.0	82.7	17.3	
★	GB3-S6	0.0	25.00	1.92	0.594	0.1601	20.1	73.2	6.7	
✕	H-CREEK	0.0	0.60	0.01			0.0	1.1	44.4	54.5

GRADATION CURVES

HARZA

Job No.
Project HAMILTON LAKE ENHANCEMENT -

Date 9.9.91



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

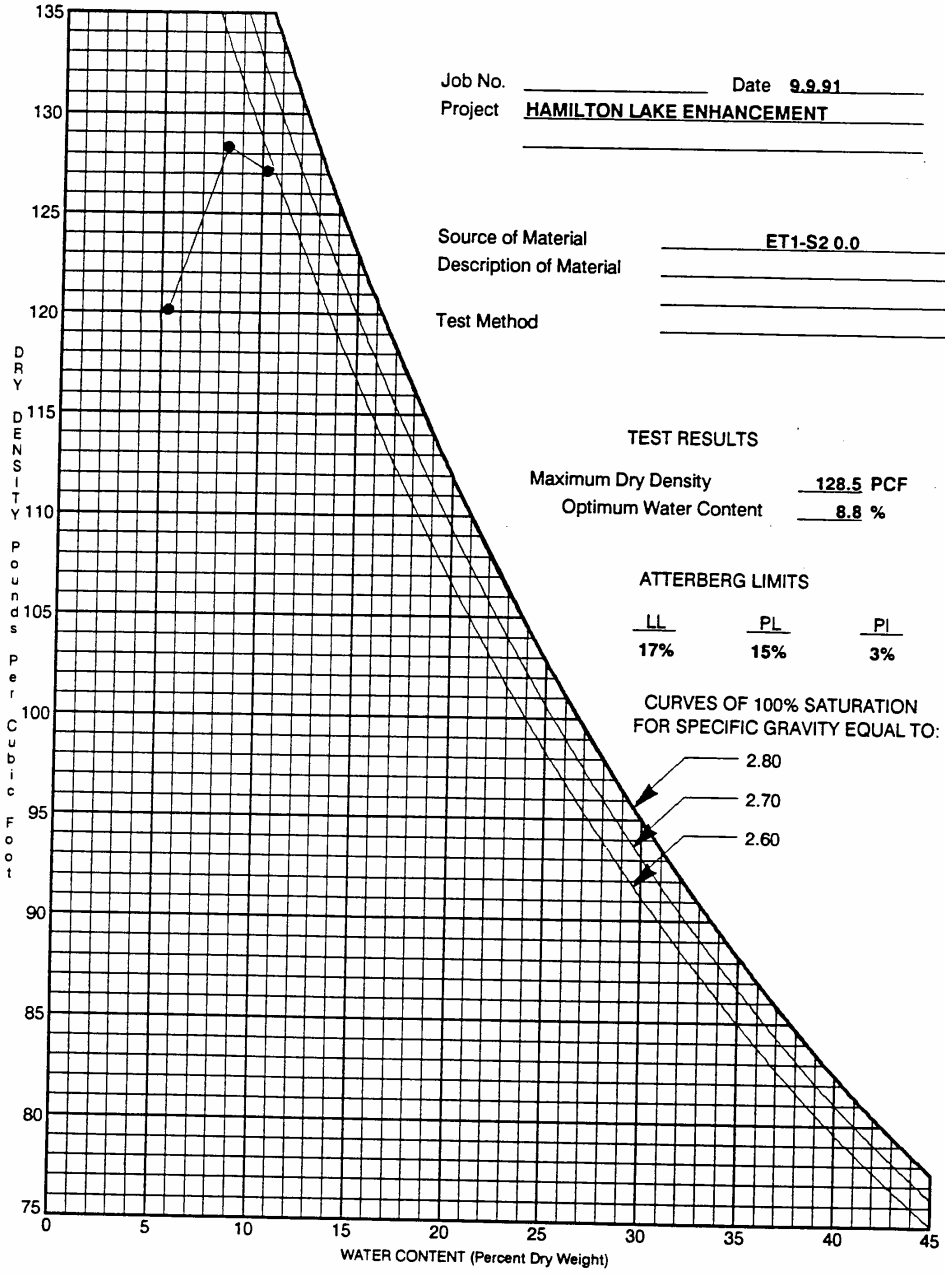
Specimen Identification		Classification	MC%	LL	PL	PI	Cc	C
● HT1-S2	0.0	SILTY SAND SM	23	21	20	1		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Cla
● HT1-S2	0.0	50.00	0.48	0.089	0.0024	8.5	62.3	16.3	12.9

GRADATION CURVES

APPENDIX D - LABORATORY TEST DATA

HARZA



Job No. _____ Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT

Source of Material ET1-S2 0.0

Description of Material

Test Method

TEST RESULTS

Maximum Dry Density 128.5 PCF

Optimum Water Content 8.8 %

ATTERBERG LIMITS

LL	PL	PI
17%	15%	3%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

2.80

2.70

2.60

MOISTURE-DENSITY RELATIONSHIP

HARZA

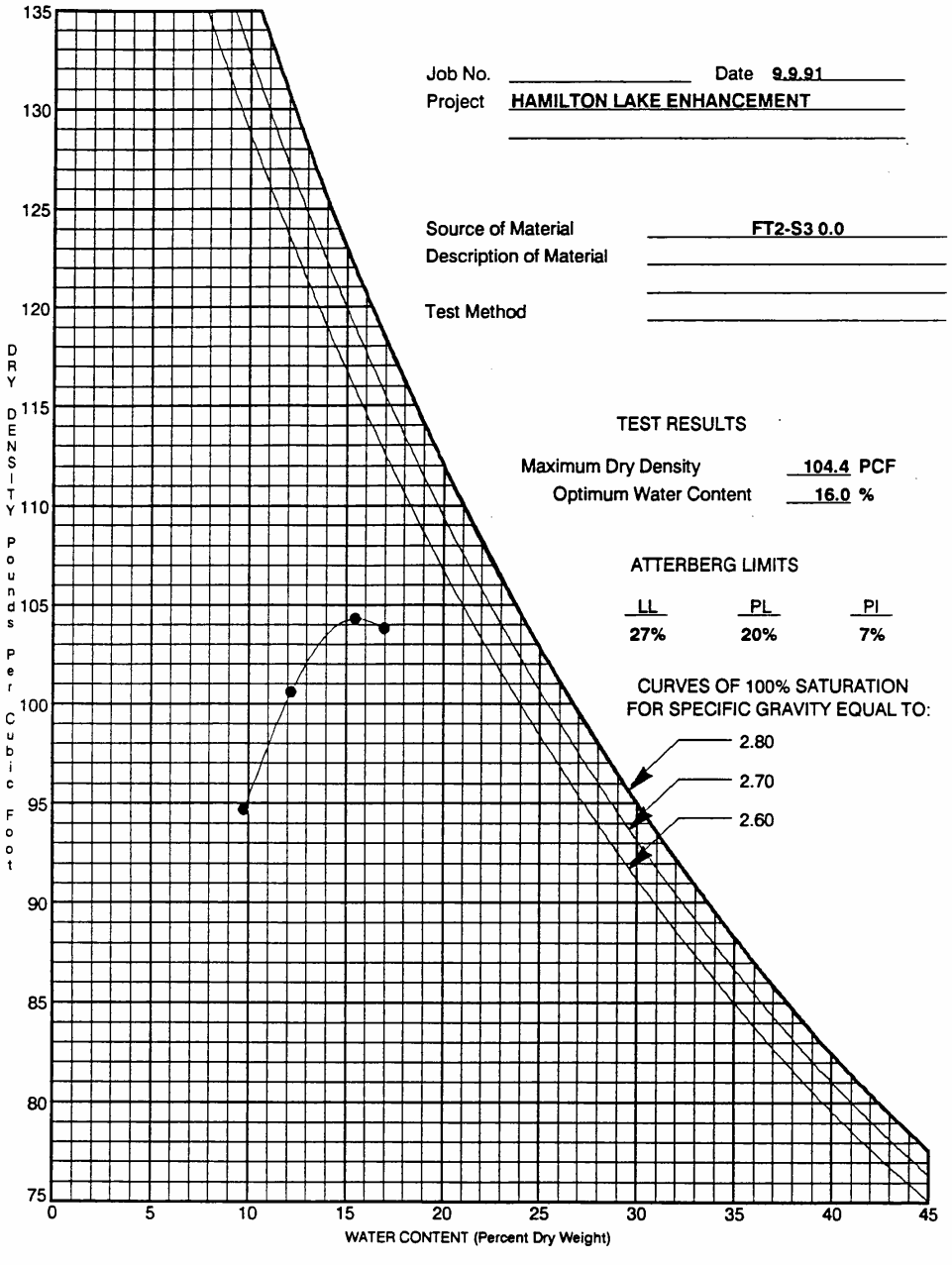
Job No. _____ Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT

Source of Material FT2-S3 0.0

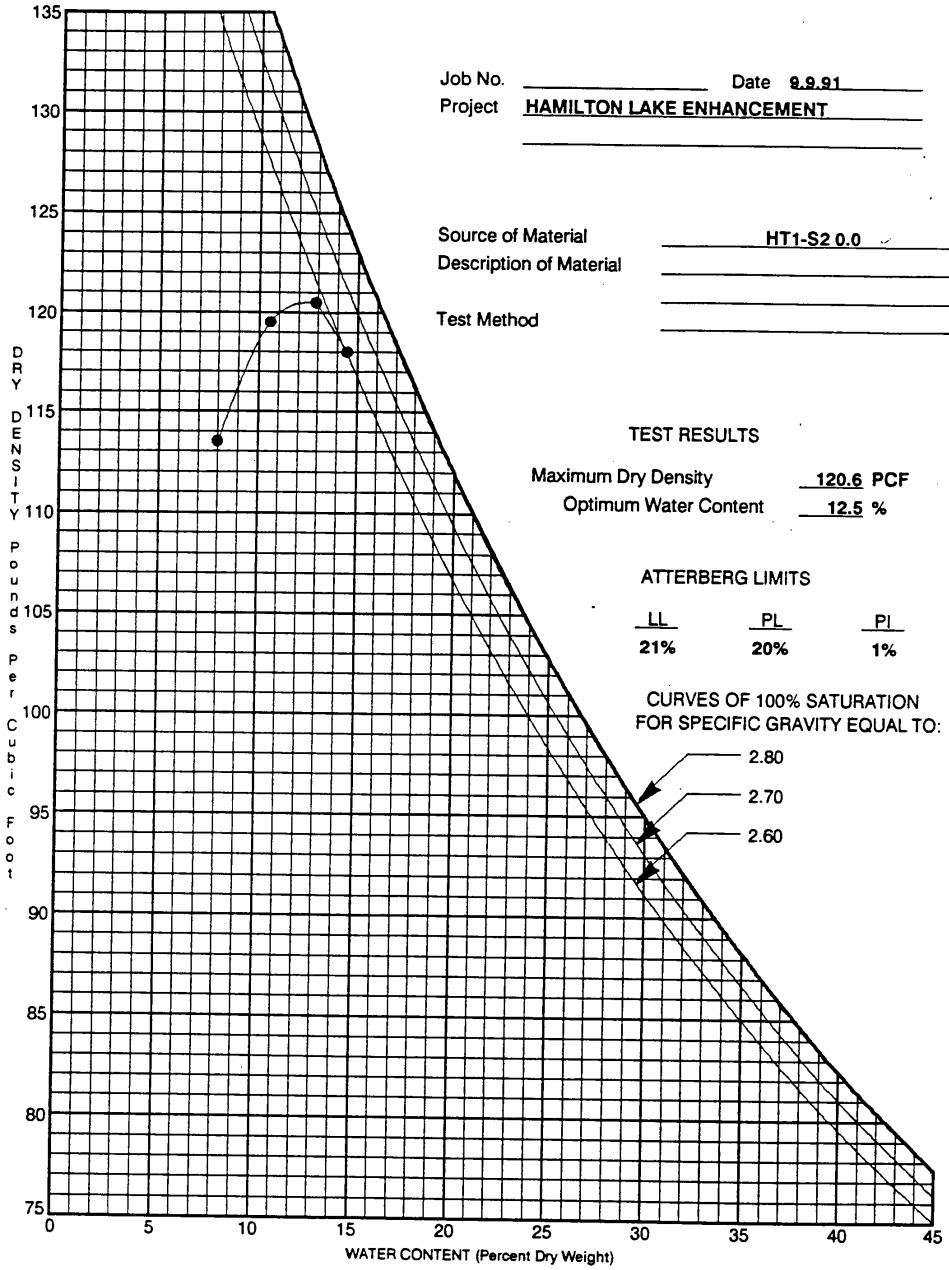
Description of Material _____

Test Method _____



MOISTURE-DENSITY RELATIONSHIP

HARZA



Job No. _____ Date 9.9.91

Project HAMILTON LAKE ENHANCEMENT

Source of Material HT1-S2 0.0

Description of Material

Test Method

TEST RESULTS

Maximum Dry Density 120.6 PCF

Optimum Water Content 12.5 %

ATTERBERG LIMITS

LL	PL	PI
21%	20%	1%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

2.80

2.70

2.60

MOISTURE-DENSITY RELATIONSHIP

APPENDIX E

MA

DEC 08 1998

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES

CERTIFICATE OF APPROVAL
CONSTRUCTION IN A FLOODWAY

APPLICATION #: FW-18,256

STREAM : Haughey Ditch

APPLICANT : Hamilton Lake Association
Jerry Smith
P.O. Box 515
Hamilton IN 46742

AGENT : Harza Engineering Company
David W. Miller
425 Roland Way
Oakland CA 94621

AUTHORITY : IC 14-28-1 with 310 IAC 6-1

DESCRIPTION : A steel sheet pile in-channel weir will be built across Haughey Ditch to create a 7.5-acre detention area that will enhance an adjacent wetland and will also capture sediment flowing into Hamilton Lake. The weir will have a maximum length of 47', a top width of 5', a crest elevation of 956.25', NGVD, and a 6' wide "V"-notch with a minimum elevation of 953.0', NGVD. All excavated material will be placed in upland disposal areas outside of the delineated wetland. Riprap placed over filter fabric will be keyed into the bank a minimum of 2' and will extend from the intersection of the weir and the natural bank slopes to 5' landward from the edges of the sheet piling. Riprap over filter fabric will also be placed in the channel immediately downstream of the constructed spillway. Details of the project are contained in plans and information received at the Division of Water on March 25, 1997, May 19, 1997, September 23, 1997, October 1, 1997, February 6, 1998 and August 11, 1998.

LOCATION : Across the stream, approximately 600' upstream (west) of the C.R. 600 East stream crossing near Hamilton, Otsego Township, Steuben County
W½, NE¼, NE¼, Section 23, T 36N, R 14E, Hamilton Quadrangle
UTM Coordinates: Downstream = 4604050 North, 676975 East

APPROVED BY :

Michael W. Neyer, PE
Director
Division of Water

APPROVED ON : December 4, 1998

Attachments: Notice Of Right To Administrative Review
General Conditions
Special Conditions
Service List

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES

NOTICE OF RIGHT TO ADMINISTRATIVE REVIEW

APPLICATION #: FW-18,256

This signed document constitutes the issuance of a permit by the Natural Resources Commission, or its designee, subject to the conditions and limitations stated on the pages entitled "General Conditions" and "Special Conditions".

The permit or any of the conditions or limitations which it contains may be appealed by applying for administrative review. Such review is governed by the Administrative Orders and Procedures Act, IC 4-21.5, and the Department's rules pertaining to adjudicative proceedings, 312 IAC 3-1.

In order to obtain a review, a written petition must be filed with the Division of Hearings within 18 days of the mailing date of this notice. The petition should be addressed to:

Mr. Stephen L. Lucas, Director
Division of Hearings
Room W272
402 West Washington Street
Indianapolis, Indiana 46204

The petition must contain specific reasons for the appeal and indicate the portion or portions of the permit to which the appeal pertains.

If an appeal is filed, the final agency determination will be made by the Natural Resources Commission following a legal proceeding conducted before an Administrative Law Judge. The Department of Natural Resources will be represented by legal counsel.

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES

GENERAL CONDITIONS

APPLICATION #: FW-18,256

(1) If any archaeological artifacts or human remains are uncovered during construction, federal law and regulations (16 USC 470, et seq.; 36 CFR 800.11, et al) and State law (IC 14-21-1) require that work must stop and that the discovery must be reported to the Division of Historic Preservation and Archaeology within 2 business days.

Division of Historic Preservation and Archaeology
Room W274
402 West Washington Street
Indianapolis, Indiana 46204

Telephone: (317) 232-1646, FAX: (317) 232-8036

(2) This permit must be posted and maintained at the project site until the project is completed.

(3) This permit does not relieve the permittee of the responsibility for obtaining additional permits, approvals, easements, etc. as required by other federal, state, or local regulatory agencies. These agencies include, but are not limited to:

Agency	Telephone Number
Detroit District, U.S. Army Corps of Engineers	(313) 226-2218
Indiana Department of Environmental Management	(317) 233-2471
Maumee River Basin Commission	(219) 449-7226
Steuben County Drainage Board	(219) 665-5117
Local city or county planning or zoning commission	Check local directory

(4) This permit must not be construed as a waiver of any local ordinance or other state or federal law.

(5) This permit does not relieve the permittee of any liability for the effects which the project may have upon the safety of the life or property of others.

(6) This permit may be revoked by the Department of Natural Resources for violation of any condition, limitation, or applicable statute or rule.

(7) This permit shall not be assignable or transferable without the prior written approval of the Department of Natural Resources. To initiate a transfer contact:

Mr. Michael W. Neyer, PE, Director
Division of Water
Room W264
402 West Washington Street
Indianapolis, Indiana 46204

Telephone: (317) 232-4160, FAX: (317) 233-4579

(8) The Department of Natural Resources shall have the right to enter upon the site of the permitted activity for the purpose of inspecting the authorized work.

(9) The receipt and acceptance of this permit by the applicant or authorized agent shall be considered as acceptance of the conditions and limitations stated on the pages entitled "General Conditions" and "Special Conditions".

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES
SPECIAL CONDITIONS

APPLICATION #: FW-18,256

PERMIT VALIDITY: This permit is valid for 24 months from the "Approved On" date shown on the first page. If work has not been initiated by December 4, 2000 the permit will become void and a new permit will be required in order to continue work on the project.

This permit becomes effective 18 days after the "MAILED" date shown on the first page. If both a petition for review and a petition for a stay of effectiveness are filed before this permit becomes effective, any part of the permit that is within the scope of the petition for stay is stayed for an additional 15 days.

CONFORMANCE : Other than those measures necessary to satisfy the "General Conditions" and "Special Conditions", the project must conform to the information received by the Department of Natural Resources on: March 25, 1997, May 19, 1997, September 23, 1997, October 1, 1997, February 6, 1998 and August 11, 1998. Any deviation from the information must receive the prior written approval of the Department.

Number	Special Condition
(1)	revegetate all bare and disturbed areas with a mixture of grasses (excluding all varieties of tall fescue) and legumes as soon as possible upon completion
(2)	appropriately designed measures for controlling erosion and sediment must be implemented to prevent sediment from entering the stream or leaving the construction site; maintain these measures until construction is complete and all disturbed areas are stabilized
(3)	do not clear or dredge in the ditch or upstream of the weir during construction
(4)	do not clear vegetation except for where the weir is constructed
(5)	after construction, remove sediment deposited immediately upstream of the structure; limit the zone of sediment removal to the area within 50' of the structure
(6)	do not clear vegetation from the wetland after construction except for any vegetation that may be cleared within 50' of the structure when the accumulated sediment is removed
(7)	except for the material used as backfill as shown on the above referenced project plans on file at the Division of Water, place all excavated material landward of the floodway
(8)	do not leave felled trees, brush, or other debris in the floodway
(9)	all riprap placed for bank stabilization must conform to the bank
(10)	upon completion of the project, remove all construction debris from the floodway

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES

SERVICE LIST

APPLICATION #: FW-18,256

Hamilton Lake Association
Jerry Smith
P.O. Box 515
Hamilton IN 46742

Harza Engineering Company
David W. Miller
425 Roland Way
Oakland CA 94621

Kathleen Harris
6025 East 500 South
Hamilton IN 96742

Regulatory Functions Branch
Detroit District, USACOE
c/o Mr. Gary Mannesto
P.O. Box 1027
Detroit MI 48231-1027

Maumee River Basin Commission
c/o Rodney Renkenberger Exec Dir.
Room B-80
City County Building
Fort Wayne IN 46802

Steuben County Drainage Board
Attn: County Surveyor
317 South Wayne, Suite 3-K
Angola IN 46703

Steuben County
Soil and Water Conservation District
Peachtree Plaza 200
1220 North 200 West
Angola IN 46703

Division of Law Enforcement, IDNR
North Region Headquarters (Dist 2)
c/o Capt. Bruce Clear
RR 6, Box 344
Peru IN 46970

Steuben County Plan Commission
317 S. Wayne, Suite 3-L
Angola In 46703

Staff Assignment
Administrative: Markita L. Shepherdson
Technical : Matthew D. Patton
Environmental : Stephen H. Jose

DEPARTMENT OF THE ARMY
DETROIT DISTRICT, CORPS OF ENGINEERS
REGULATORY BRANCH
SOUTH BEND FIELD OFFICE
2422 VIRIDIAN DRIVE SUITE # 101
SOUTH BEND, INDIANA 46628

November 30, 1999

IN REPLY REFER TO

File No. 96-176-054-0

Harza Engineering Company, Inc.
Douglas Mulvey
233 S. Wacker Dr.
Chicago, Illinois 60606-6392

Dear Mr. Mulvey:

Please refer to your October 14, 1999 letter requesting an extension of time to create and enhance wetlands in Haughey Ditch located northeast of Hamilton Lake in Steuben County, Indiana (Section 23, Township 36N., Range 14E.). By letter dated May 6, 1997, we verified that work proposed by the Hamilton Lake Association is authorized by our regulations for nationwide permits. As you may recall, a Nationwide Permit is a blanket permit whereby a class of activities can receive Department of Army authorization with a minimal amount of administrative review.

The purpose of this letter is to inform you that we have verified that the revised proposal still complies with, and is therefore authorized under the Nationwide Permits as issued in the Federal Register December 13, 1996 (61 FR 65874). Based on our review of the revised plans (copy enclosed), the project has been reduced in size and will result in a 7.5 acre detention area. A steel sheet pile in-channel weir will replace the original earthen dam detention structure. Approximately 45 cubic yards of riprap will be discharged around the structure for erosion protection. All of the original conditions remain in full force and effect. The nationwides also require you to submit the enclosed COMPLETION REPORT to this office when the work is finished.

Any proposed further revision or modification to the project may not qualify for the authorization. If you contemplate any changes or additional activities from those depicted on the enclosed plans, please submit them to this office for authorization review prior to any construction. Failure to secure the necessary approvals may result in the initiation of legal action against the responsible parties.

This verification is valid for 2 years from the date of this letter unless the blanket Nationwide Permit is modified, suspended, or revoked. If you have any questions, please contact me at the above address or telephone (219) 232-1952. Please refer to File Number: 96-176-054-0.

Sincerely,

Gregory A. McKay

Gregory A. McKay
Biologist
South Bend Field Office

Enclosures

Copies Furnished

Hamilton Lake Association

NATIONWIDE PERMIT COMPLETION REPORT

Detroit District, Corps of Engineers

CELRE-CO-L 96-176-054-0

Commander
U.S. Army Engineer District, Detroit
ATTN: Regulatory Branch
P.O. Box 1027
Detroit, Michigan 48231-1027

Dear Sir:

This is in regard to Department of the Army File No. 96-176-054-0, issued to Hamilton Lake Association on November 30, 1999, to create and enhance wetlands in Haughey Ditch in Steuben County, Indiana. I hereby certify that the work authorized by the above referenced permit has been completed in accordance with the terms and conditions of the permit, and required mitigation was completed in accordance with the permit conditions.

The work was completed on: _____
(Date work completed)

_____ _____
(Signature of Permittee) (Date)

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the above address, within 10 days after completion of work.

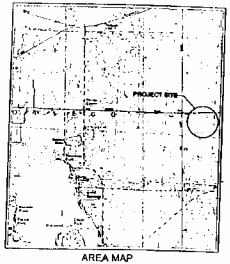
Please note that your permitted activity is subject to compliance inspection by the U.S. Army Corps of Engineers' representatives. If you fail to comply with this permit you are subject to permit suspension, modification or revocation.

HAMILTON LAKE ASSOCIATION, INC.
HAMILTON, INDIANA

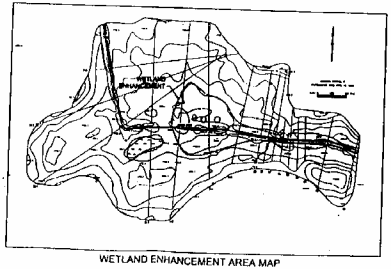
HAMILTON LAKE WETLAND ENHANCEMENT PROJECT
August 1999

NOTES:

1. THE STEEL SHEET PILE SHALL BE PSX 32 (USS) WITH ASTM A328 CARBON GRADE OR EQUAL. SEE TYPICAL SECTION ON SHEET 2.
2. THE ALIGNMENT OF THE CONTROL STRUCTURE IS APPROXIMATELY PERPENDICULAR TO THE CENTER LINE OF DRAINAGE DITCH. THE FINAL ALIGNMENT SHALL BE ADJUSTED TO AN ALIGNMENT THAT WILL PROVIDE THE MOST SUITABLE FOUNDATION FOR THE STRUCTURE AND ACCEPTABLE FLOW CONDITION (RAN. ALIGNMENT IS SUBJECT TO THE APPROVAL OF THE HAMILTON LAKE ASSOCIATION.
3. THE MINIMUM EMBEDMENT LENGTH SHALL BE 5 FEET, FROM THE TOP OF DENSE SOIL OR GRAVEL, THE DESIGN ASSUMES EL. 161.
4. THE FINAL ALIGNMENT OF THE STRUCTURE SHALL BE ADJUSTED TO MINIMIZE INTERFERENCE FROM BURIED DEBRIS WHICH MAY DEFECT DRIVING OF SHEET PILE.

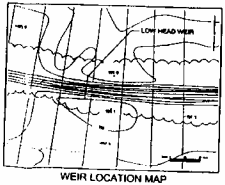


AREA MAP



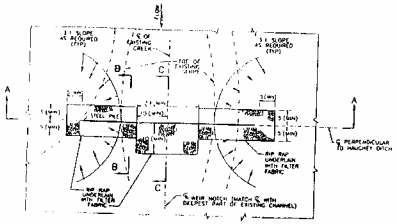
WETLAND ENHANCEMENT AREA MAP

DRAWING INDEX	
SHEET No.	DRAWING TITLE
SHEET 1	COVER / GENERAL NOTES
SHEET 2	SEDIMENT CONTROL STRUCTURE

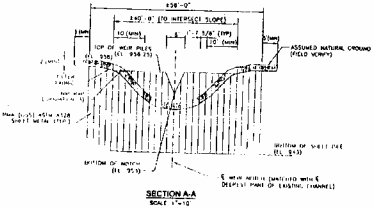


WEIR LOCATION MAP

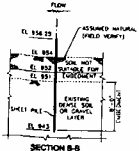
HARZA ENGINEERING COMPANY
WATER & ENVIRONMENT
SEARS TOWER - 233 South Wacker Drive - Chicago, Illinois 60606-6302 - Tel: (312) 831-3800 - Fax: (312) 831-3978



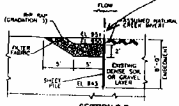
PLAN
SCALE 1"=10'



SECTION A-A
SCALE 1"=10'

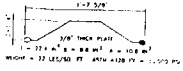


SECTION B-B
SCALE 1"=5'



SECTION C-C
SCALE 1"=5'

sheet pile up (Solid is) to 953



TYP. SECTION OF SHEET PILE
NOT TO SCALE

NOT TO SCALE

APPROVED			ENGINEER'S SEAL
DESIGN		REVIEWED	
DRAWN		CIVIL	
CHECKED		MECH.	
SURVEY		ELECT.	

HAMILTON LAKE ASSOCIATION, INC.
HAMILTON, INDIANA

HAMILTON LAKE WETLAND ENHANCEMENT PROJECT

SEDIMENT TRAP
PLAN AND SECTION

HARZA ENGINEERING COMPANY INTERNATIONAL

INDIANA DEPARTMENT OF NATURAL RESOURCES

PATRICK R. RALSTON, DIRECTOR

Division of Historic Preservation
and Archaeology
402 W. Washington St., Rm. 274
Indianapolis, Indiana 46204
317-232-1646

March 24, 1992

David W. Miller, PE
Project Manager
Harza Engineering Company
Sears Tower
233 South Wacker Drive
Chicago, Illinois 60606-6392

Dear Mr. Miller:

We have reviewed the proposed construction of six artificial wetlands to improve the water quality of Hamilton Lake (DNR #4437) located in Steuben County, Indiana.

No known historical or architectural sites listed in or eligible for inclusion in the National Register of Historic Places will be affected by this project.

A review of our records and references has revealed that Project Locations A, G, and H are very poorly drained and are therefore unlikely to contain significant archaeological resources. However, Project Locations B, E, and F appear to be physiographically suitable to contain archaeological sites.

Given these factors, a reconnaissance level archaeological survey will be required for Project Locations B, E, and F prior to construction. The survey must be done in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716). A description of the survey methods and results must be submitted to the Division of Historic Preservation and Archaeology for review before we can comment further. Please refer to the enclosed list of qualified archaeologists.

In the event that sites which are eligible for the National Register are discovered, the applicant must follow the rules and regulations established by the Advisory Council on Historic Preservation (found at 36 CFR Part 800) to implement federal Public Laws 89-665, 94-422, and 96-515, and Executive Order 11593. Regulations for implementing these laws are found in 36 CFR 800.

We appreciate the opportunity to be of service.

Very truly yours,

Patrick R. Ralston
State Historic Preservation Officer

PRR:JAM:vk

Enclosure

APPENDIX F

HAMILTON LAKE SEDIMENT TRAP
INSPECTION AND MAINTENANCE
REPORT FORM

TO BE COMPLETED EVERY SUMMER

INSPECTOR: DATE:
PREVIOUS INSPECTION DATE:
CONCLUSIONS:

WETLAND VEGETATION

CONDITION OF VEGETATION		
SEDIMENT BASIN SHORELINE	LOW HEAD WEIR CREST	OUTSIDE LOW HEAD WEIR

OTHER OBSERVATIONS:

MAINTENANCE REQUIRED FOR WETLAND VEGETATION:

TO BE PERFORMED BY: ON OR BEFORE:

COMPLETED BY: DATE:

COMMENTS:

HAMILTON LAKE SEDIMENT TRAP
INSPECTION AND MAINTENANCE
REPORT FORM

TO BE COMPLETED EVERY SUMMER

INSPECTOR: DATE:
PREVIOUS INSPECTION DATE:
CONCLUSIONS:

LOW HEAD WEIR

CONDITION OF CREST	CONDITION OF SIDE SLOPES	EVIDENCE OF SLOUGHING?

OTHER OBSERVATIONS:

MAINTENANCE REQUIRED FOR LOW HEAD WEIR:

TO BE PERFORMED BY: ON OR BEFORE:

COMPLETED BY: DATE:

COMMENTS:

HAMILTON LAKE SEDIMENT TRAP
INSPECTION AND MAINTENANCE
REPORT FORM

TO BE COMPLETED EVERY SUMMER

INSPECTOR: DATE:
PREVIOUS INSPECTION DATE:
CONCLUSIONS:

SEDIMENT BASIN

SEDIMENT ACCUMULATION					CONDITION OF BASIN SLOPES	CONDITION OF STORM WATER INFLOW CULVERT
INSPECTION POINTS		CONSISTENCY OF SEDIMENT	DEPTH TO FIRM SEDIMENT	ELEVATION OF FIRM SEDIMENT		
NO.	LOCATION					

OTHER OBSERVATIONS:

MAINTENANCE REQUIRED FOR SEDIMENT BASIN:

TO BE PERFORMED BY: ON OR BEFORE:

COMPLETED BY: DATE:

COMMENTS:

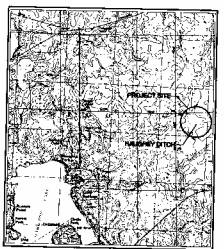
APPENDIX G

HAMILTON LAKE ASSOCIATION, INC.
HAMILTON, INDIANA

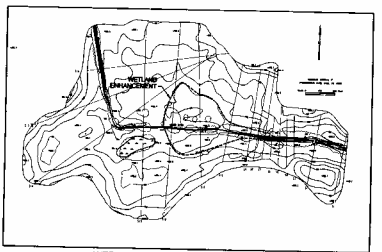
HAMILTON LAKE WETLAND ENHANCEMENT PROJECT
August 1999

NOTES:

1. THE STEEL SHEET PILE SHALL BE PMA 23 (UNI) ASTM A328 CARBON GRADE OR EQUAL. SEE TYPICAL SECTION ON SHEET 2.
2. THE ALIGNMENT OF THE CONTROL STRUCTURE IS APPROXIMATELY PERPENDICULAR TO THE CENTER LINE OF HAUGHEY DITCH. THE FINAL ALIGNMENT SHALL BE ADJUSTED TO AN ALIGNMENT THAT WILL PROVIDE THE MOST SUITABLE FOUNDATION FOR THE STRUCTURE AND ACCEPTABLE FLOW CONDITION. FINAL ALIGNMENT IS SUBJECT TO THE APPROVAL OF THE HAMILTON LAKE ASSOCIATION.
3. THE MINIMUM EMBEDMENT LENGTH SHALL BE 6 FEET FROM THE TOP OF DENSE SOIL OR GRAVEL. THE DESIGN ASSUMES EL 681.
4. THE FINAL ALIGNMENT OF THE STRUCTURE SHALL BE ADJUSTED TO MINIMIZE INTERFERENCE FROM BURIED OBSTRUCTIONS WHICH MAY IMPEDE DRIVING OF SHEET PILE.

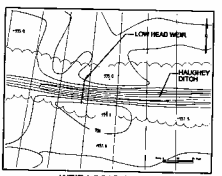


AREA MAP



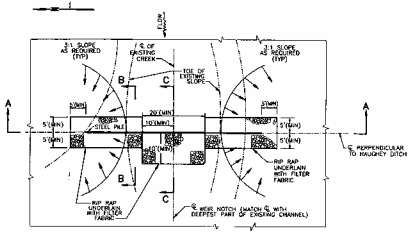
WETLAND ENHANCEMENT AREA MAP

DRAWING INDEX	
SHEET No.	DRAWING TITLE
15087-01	COVER / GENERAL NOTES
15087-02	SEDIMENT CONTROL STRUCTURE

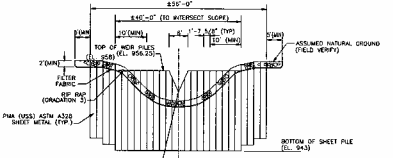


WEIR LOCATION MAP

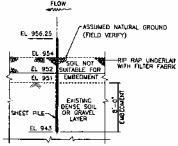
HARZA ENGINEERING COMPANY
WATER & ENVIRONMENT
SEARS TOWER • 233 South Wacker Drive • Chicago, Illinois 60606-6392 • Tel: (312) 831-3800 • Fax: (312) 831-3976



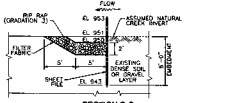
PLAN
SCALE 1"=10'



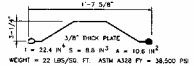
SECTION A-A
SCALE 1"=10'



SECTION B-B
SCALE 1"=5'



SECTION C-C
SCALE 1"=5'



WEIGHT = 22 LBS/SQ. FT. ASTM A328 FY = 38,500 PSI

TYP. SECTION OF SHEET PILE
NOT TO SCALE

APPROVED		ENGINEER'S SEAL
DSGN.	REVIEWED	
DWG.	CIVIL	
CHK.	MECH.	
CHKD.	ELECT.	
SUBM.		

REV. NO.	DWG. TRANSMITTAL LETTER NO.	DATE	NATURE OF REVISION	BY	CHKD	APPD.

HAMILTON LAKE ASSOCIATION, INC.
HAMILTON, INDIANA

HAMILTON LAKE WETLAND ENHANCEMENT PROJECT

SEDIMENT TRAP PLAN AND SECTION

HARZA ENGINEERING COMPANY WATER & ENVIRONMENT — CHICAGO, ILLINOIS

PROJECT MANAGER

DATE: AUGUST, 1999

DRAWING No. 1587-07

SUBJECT Hamilton Lake QTOs
COMPUTED DLM DATE 8/17/99
CHECKED DATE
BACKCHECKED DATE
PROJECT NAME Hamilton Lake
PROJECT NUMBER 15087
Page 1 of 2 Pages

Rip Rap = $\{(20')(10')(2') + 2[(10')(18')(2')]\}\left(\frac{yd^3}{27 ft^3}\right) = 41.5\ yd^3$

Sheet Pile = $(56')(13.25') = 742\ ft^2$

Filter Fabric = $(20')(10') + 2(10')(18') = 560\ ft^2\left(\frac{yd^2}{9 ft^2}\right) = 62\ SY$

Excavation = Rip Rap = $41.5\ yd^3$

Prices

Sheet pile $31 ft^2 installed

excavation soft material small jobs $21 yd^3

rip-rap $30 ton installed for RR3 ~ 2 tons/CY

geotextile $6 sq yd

Costs

Dewatering of Work Area	=	$5,000
Sediment Sampling + Testing	= 3 samples @ $500/sample	= $1,500
Sheet pile	= $(742\ ft^2)(\$31/ft^2) \cong$	$23,000
Excavation	= $(\$21/yd^3)(41.5\ yd^3) \cong$	$1000
Rip Rap	= $(\$30/ton)\left(\frac{2\ ton}{yd^3}\right)(41.5\ yd^3) \cong$	$2500
Geotextile	= $(\$6/yd^2)(62\ yd^2) \cong$	$500
Mobilization/Demobilization		$10,000
Clearing & Grubbing		$3,000
Restoration		$3,000
Surveying		$5,000
SubTotal		$57,500

SUBJECT

COMPUTED DATE
CHECKED DATE
BACKCHECKED DATE

PROJECT NAME Hamilton Lake
PROJECT NUMBER 15087
Page 2 of 2 Pages

Construction Inspection/Administration	+10%	5,750
Contingency	+25%	15,800
TOTAL		$ 79,000